UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, DC 20549

FORM 10-K

x **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31, 2019

or

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from to

Commission File Number: 001-36281

DICERNA PHARMACEUTICALS, INC.
(Exact name of registrant as specified in its charter)

Delaware	**20-5993609**
(State or other jurisdiction of incorporation or organization)	**(IRS Employer Identification No.)**

33 Hayden Avenue, Lexington, MA 02421
(Address of principal executive offices and zip code)
(617) 621-8097
(Registrant's telephone number, including area code)

Securities registered pursuant to Section 12(b) of the Act:

Title of Each Class	Trading Symbol(s)	Name of Each Exchange on Which Registered
Common Stock, $0.0001 Par Value	DRNA	The Nasdaq Global Select Market

Securities registered pursuant to Section 12(g) of the Act:
None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes x No ☐

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No x

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days) Yes x No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes x No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	x	Accelerated filer	☐
Non-accelerated filer	☐	Smaller reporting company	x
		Emerging growth company	☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Act) Yes ☐ No x

The aggregate market value of the registrant's common stock held by non-affiliates of the registrant on June 30, 2019 was approximately $919.3 million based on the last reported sale of the registrant's common stock on The Nasdaq Global Select Market on June 28, 2019 of $15.75 per share.

As of February 24, 2020, there were 73,750,617 shares of the registrant's common stock, par value $0.0001 per share, outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's definitive proxy statement for its 2020 Annual Meeting of Stockholders are incorporated by reference into Part III hereof. Such proxy statement will be filed with the Securities and Exchange Commission not later than 120 days after the end of the fiscal year covered by this Annual Report on Form 10-K.

DICERNA PHARMACEUTICALS, INC.
2019 ANNUAL REPORT ON FORM 10-K
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SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K includes "forward-looking statements" within the meaning of Section 27A of the Securities Act of 1933, as amended (the "Securities Act"), and Section 21E of the Securities Exchange Act of 1934, as amended (the "Exchange Act"). All statements other than statements of historical fact are "forward-looking statements" for purposes of this Annual Report on Form 10-K. In some cases, you can identify forward-looking statements by terminology such as "may," "could," "will," "would," "should," "expect," "plan," "anticipate," "believe," "estimate," "intend," "predict," "seek," "contemplate," "project," "continue," "potential," "ongoing," "goal," or the negative of these terms or other comparable terminology. These forward-looking statements include, but are not limited to, statements about:

- the initiation, timing, progress, and results of our research and development programs, preclinical studies, any clinical trials and Investigational New Drug Applications, Clinical Trial Applications, New Drug Applications and other regulatory submissions;
- our alignment with the U.S. Food and Drug Administration on regulatory approval requirements;
- our ability to identify and develop product candidates for the treatment of additional disease indications;
- our or a collaborator's ability to obtain and maintain regulatory approval of any of our product candidates;
- the rate and degree of market acceptance of any approved product candidates;
- the commercialization of any approved product candidates;
- our ability to establish and maintain existing and additional collaborations and retain commercial rights for our product candidates in the collaborations;
- the implementation of our business model and strategic plans for our business, technologies, and product candidates;
- how long we expect to maintain liquidity to fund our planned level of operations and our ability to obtain additional funds for our operations;
- our estimates of our expenses, ongoing losses, future revenue, and capital requirements;
- our ability to obtain and maintain intellectual property protection for our technologies and product candidates and our ability to operate our business without infringing the intellectual property rights of others;
- our reliance on third parties to conduct our preclinical studies or any clinical trials;
- our reliance on third-party suppliers and manufacturers to supply the materials and components for, manufacture, and research and develop our preclinical and clinical trial drug supplies;
- our ability to attract and retain qualified key management and technical personnel;
- our dependence on our existing collaborators, Novo Nordisk A/S, F. Hoffmann-La Roche Ltd and Hoffmann-La Roche Inc., Eli Lilly and Company, Alexion Pharmaceuticals, Inc., and Boehringer Ingelheim International GmbH, for developing, obtaining regulatory approval for, and commercializing product candidates in the collaborations;
- our receipt and timing of any potential milestone payments or royalties under our existing research collaborations and license agreements or any future arrangements with our existing collaboration partners or any other collaborators;
- our financial performance; and
- developments relating to our competitors or our industry.

These statements relate to future events or to our future financial performance and involve known and unknown risks, uncertainties, and other factors that may cause our actual results, performance, or achievements to be materially different from any future results, performance, or achievements expressed or implied by these forward-looking statements. Factors that may cause actual results to differ materially from current expectations include, among other things, those set forth in Part I, Item 1A – "Risk Factors" below and for the reasons described elsewhere in this Annual Report on Form 10-K. Any forward-looking statement in this Annual Report on Form 10-K reflects our current view with respect to future events and is subject to these and other risks, uncertainties, and assumptions relating to our operations, results of operations, industry, and future growth. Given these uncertainties, you should not place undue reliance on these forward-looking statements. Except as required by law, we assume no obligation to update or revise these forward-looking statements for any reason, even if new information becomes available in the future.

This Annual Report on Form 10-K also contains estimates, projections, and other information concerning our industry, our business, and the markets for certain drugs, including data regarding the estimated size of those markets, their projected growth rates, and the incidence of certain medical conditions. Information that is based on estimates, forecasts, projections, or similar methodologies is inherently subject to uncertainties, and actual events or circumstances may differ materially from events and

circumstances reflected in this information. Unless otherwise expressly stated, we obtained these industry, business, market, and other data from reports, research surveys, studies, and similar data prepared by third parties, industry, medical and general publications, government data, and similar sources. In some cases, we do not expressly refer to the sources from which these data are derived.

Except where the context otherwise requires, in this Annual Report on Form 10-K, “we,” “us,” “our,” “Dicerna,” and the “Company” refer to Dicerna Pharmaceuticals, Inc. and, where appropriate, its consolidated subsidiaries.

Trademarks

This Annual Report on Form 10-K includes trademarks, service marks, and trade names owned by us or other companies. All trademarks, service marks, and trade names included in this Annual Report on Form 10-K are the property of their respective owners. Solely for convenience, the trademarks and trade names in this report may be referred to without the ® and ™ symbols, but such references should not be construed as any indicator that their respective owners will not assert, to the fullest extent under applicable law, their rights thereto.

PART I

ITEM 1. BUSINESS

Overview

Dicerna™ Pharmaceuticals, Inc. (“we,” “us,” “our,” the “Company,” or “Dicerna”) is a biopharmaceutical company using ribonucleic acid (“RNA”) interference (“RNAi”) to develop medicines that silence genes that cause or contribute to disease. The Company’s proprietary GalXC™ technology is being applied to develop what we believe will be potent, selective, and safe RNAi therapies to treat diseases involving the liver, including rare diseases, chronic liver diseases, cardiometabolic diseases, and viral infectious diseases. As we further enhance our GalXC technology, we aim to extend our focus beyond the liver to include central nervous system (“CNS”) diseases and diseases involving other bodily tissues. Dicerna aims to treat a broad range of diseases by addressing the underlying causes of illness, focusing on target genes where connections between gene and disease are well understood and documented. Dicerna intends to discover, develop, and commercialize novel therapeutics either on its own or in collaboration with pharmaceutical partners. Dicerna has strategic collaborations with Novo Nordisk A/S (“Novo”), F. Hoffmann-La Roche Ltd and Hoffmann-La Roche Inc. (together, “Roche”), Eli Lilly and Company (“Lilly”), Alexion Pharmaceuticals, Inc. (together with its affiliates, “Alexion”), and Boehringer Ingelheim International GmbH (“BI”).

All of our GalXC drug discovery and development efforts are based on the therapeutic modality of RNAi, a highly potent and specific mechanism for silencing the activity of a targeted gene. In this naturally occurring biological process, double-stranded RNA molecules induce the enzymatic destruction of the messenger ribonucleic acid (“mRNA”) of a target gene that contains sequences that are complementary to one strand of the therapeutic double-stranded RNA molecule. Our approach is to design proprietary double-stranded RNA molecules that have the potential to engage the enzyme Dicer and initiate an RNAi process to silence a specific target gene. Our GalXC RNAi platform utilizes a proprietary structure of double-stranded RNA molecules. For our current clinical programs, our GalXC RNAi platform has been configured for subcutaneous delivery to the liver. Due to the enzymatic nature of RNAi, a single GalXC molecule incorporated into the RNAi machinery can destroy hundreds or thousands of mRNAs from the targeted gene.

Strategy

We are committed to delivering transformative therapies based on our GalXC RNAi platform to patients with serious diseases, and currently our focus includes rare diseases, chronic liver diseases, cardiometabolic diseases, and viral infectious diseases. We and our collaborators have qualified dozens of disease-associated genes with clinical indications, in which an RNAi-based inhibitor may provide substantial benefit to patients.

The key elements of our strategy are as follows:

- **Create new programs in indication areas with high unmet medical need.** We intend to continue to use our proprietary GalXC RNAi technology platform to create new, high-value pharmaceutical programs. Our areas of primary focus are: (1) rare inherited diseases involving genes in the liver; (2) other therapeutic areas involving the expression of therapeutic gene targets in the liver such as chronic liver diseases, cardiometabolic diseases, and viral infectious diseases; and (3) further leveraging our successes with the GalXC platform to explore therapeutic gene targets in the CNS and other tissues.
- **Validate our product candidates and our platform in clinical proof-of-concept studies.** On September 5, 2018, we declared attainment of clinical proof-of-concept for nedosiran (formerly DCR-PHXC, which is in clinical development for primary hyperoxaluria (“PH”) type 1 (“PH1”), PH type 2 (“PH2”), and PH type 3 (“PH3”)) and are currently conducting clinical proof-of-concept studies for our RG6346 (formerly DCR-HBVS) and DCR-A1AT programs. Based on precedents in the RNAi field, we are optimistic that our preclinical studies, which showed significant knockdown of target mRNA activity and disease biomarker activity, may translate into beneficial clinical results for current and future programs.
- **Retain significant portions of the commercial rights for certain rare disease programs.** We seek to retain, subject to the evaluation of potential licensing opportunities as they may arise, a full or substantial ownership stake and to invest internally in programs for diseases with focused patient populations, such as certain rare diseases. These certain rare disease programs, which include our nedosiran and DCR-A1AT programs, represent opportunities that we believe carry a higher probability of success relative to other therapeutic platforms or modalities, with genetically and molecularly defined disease markers, high unmet medical need, a focused number of centers of excellence to facilitate reaching these patients, and the potential for more rapid clinical development paths to approval.
- **Enter into collaborations with pharmaceutical companies either for our GalXC RNAi technology platform or specific indications or therapeutic areas.** For more complex diseases with multiple gene dysfunctions and/or larger patient populations, we plan to pursue collaborations that can provide the enhanced scale, resources, and commercial infrastructure required to maximize these prospects. Our collaborations with Roche, Novo, Lilly, Alexion, and BI

exemplify this element of our strategy. We may establish collaborations with pharmaceutical companies across multiple programs or specific indication areas, either before or after clinical proof-of-concept, depending on the attractiveness of the opportunities. These collaborations have the potential to provide us with further validation of our technology platform, funding to advance our proprietary product candidates, or access to development, manufacturing, and commercial capabilities.

- **Expand the reach of GalXC to therapeutic targets beyond the liver.** Our research suggests that our GalXC platform, which was originally developed to target hepatocytes in the liver, may be adaptable to target other diverse tissues, including the CNS. Our collaboration with Lilly includes joint research involving our proprietary GalXC platform in order to generate new medicines for CNS diseases, such as neurodegenerative diseases and chronic pain, as well as for non-liver-based cardiometabolic diseases. We are also pursuing research internally to expand the reach of our GalXC platform to additional non-liver tissues and are increasing our investment in this area.
- **Leverage the experience and the expertise of our executive management team.** To execute on our strategy, we have assembled an executive management team that has extensive experience in the biopharmaceutical industry. In addition, various members of our management team and our board of directors have contributed to the progress of pharmaceutical development and commercialization through their substantial involvement in companies such as Cephalon Inc., Genta Inc., GlaxoSmithKline plc, Shire plc, Pfizer Inc., NPS Pharmaceuticals, Inc., Millennium Pharmaceuticals, Inc., Takeda Pharmaceutical Company Limited, Biogen, Inc., Sirna Therapeutics, Inc. (“Sirna”), and other companies. Our co-founder and chief executive officer, Douglas M. Fambrough III, Ph.D., was a lead venture capital investor and board member of Sirna, an early RNAi company acquired by Merck & Co., Inc. in 2006 for $1.1 billion.

RNAi and Our GalXC Technology Platform

The RNAi Therapeutic Modality

All of our GalXC drug discovery and development efforts are based on the therapeutic modality of RNAi. RNAi therapeutics represent a novel advance in drug development. Historically, the pharmaceutical industry had developed only small molecules or recombinant proteins to inhibit the activity of disease-causing proteins. While this approach is effective for many diseases, many proteins cannot be inhibited by either small molecules or recombinant proteins. Some proteins lack the binding pockets small molecules require for interaction. Other proteins are solely intracellular and therefore inaccessible to recombinant protein-based therapeutics, which are limited to cell surface and extracellular proteins. The unique advantage of RNAi is that, instead of targeting proteins, RNAi silences the genes themselves via the targeted destruction of the mRNAs made from the gene. Rather than seeking to inhibit a protein directly, the RNAi approach is to prevent its creation in the first place.

The GalXC RNAi Technology Platform

Dicerna’s GalXC technology consists of a set of proprietary double-stranded RNA structures capable of inducing RNAi and associated chemical modifications and additions to these structures that enhance their properties and help confer useful ‘drug-like’ properties. RNAi-inducing RNA structures consist of two strands of RNA. One of these strands, called the guide strand, is complementary to the mRNA sequence one is seeking to inhibit. The other strand, called the passenger strand, includes sequences complementary to the guide strand, forming a double-stranded RNA duplex with it. In the case of our GalXC technology, additional sequences are added to the passenger strand, which help improve the properties of the molecules and can serve as an attachment point for various chemical additions. We have spent several years optimizing the structure, chemical modifications, and chemical additions in our GalXC RNAi platform and will continue to do so to create what we believe is an efficient, effective, and well-tolerated pharmaceutical platform to rapidly identify and develop RNAi therapeutics for delivery to the liver and other tissues.

We believe our GalXC RNAi technology platform provides the following qualities and has advantages compared to other therapeutic modalities:

- **Our GalXC molecules have been optimized for use in humans.** For therapeutic use in humans, our GalXC molecules are optimized both with respect to base sequence and chemical modifications to increase stability and mask them from mechanisms that recognize foreign RNA, in order to avoid inducing immune system stimulation. Our optimization process begins with an analysis of the target gene sequence using our proprietary GalXC prediction algorithm, which we developed based on the results of testing thousands of sequences for RNAi activity. We select the sequences with the highest predicted RNAi activity and apply patterns of chemical modifications and additions, including a four-base sequence, known as a tetraloop, on the passenger strand, which is designed to enhance stability and engineer out immunostimulatory activity.
- **Our GalXC RNAi platform enables subcutaneous dosing for delivery to the liver.** The GalXC RNAi platform is designed to enable convenient subcutaneous delivery for our growing pipeline of liver-targeted RNAi programs. Our liver-targeted GalXC molecules are conjugated on the tetraloop structure to a simple sugar, *N*-acetyl-D-galactosamine

("GalNAc"), that is specifically recognized by a receptor on the surface of hepatocytes. With the liver-targeted GalXC RNAi platform, a full human dose may be administered via a single subcutaneous injection. After injection, the GalXC molecules enter the bloodstream and are exposed to the hepatocytes expressing the GalNAc receptor. After binding to the receptor, the GalXC molecules are internalized by the hepatocyte, ultimately enabling the GalXC molecules to access the RNAi machinery inside the hepatocyte. Our liver-targeted GalXC molecules routinely achieve high potencies, with EC50 values in the liver (i.e., the amount of material required to silence a target gene by 50 percent) typically in the 0.1 to 1.0 milligram per kilogram bodyweight (mg/kg) range in *in vivo* studies in mice. We have routinely generated GalXC molecules of this potency within 30 days of doing the initial algorithmic gene sequence analysis, which allows us to explore a large number of potential target genes when selecting programs for ourselves and with our collaborators.

- **Our GalXC molecules have a long duration of action.** We believe our GalXC RNAi platform allows us to build a broad pipeline of therapeutics designed to have attractive pharmaceutical properties, including infrequent dosing (e.g., dosing that is on a monthly, quarterly, or an even less frequent basis) due to a long duration of action and higher potency of RNAi-based gene silencing.
- **Our GalXC molecules are highly specific to the gene to which they are targeted.** Due to the gene-sequence-based nature of how our GalXC molecules interact with their gene mRNA targets, facilitated by the RNAi pathway proteins inside the cell, we believe our GalXC molecules generally lack any direct effect on other gene targets. This specificity compares favorably to many small molecule-based therapeutics, which may inhibit additional proteins beyond the intended protein target.
- **Our GalXC molecules have demonstrated a high therapeutic index.** In both preclinical studies and clinical studies, our GalXC molecules have been shown to be well-tolerated, even at dose levels far exceeding the expected efficacious dose level. We believe this property reduces the risk that our GalXC molecules may have tolerability liabilities that may preclude further development.
- **Our GalXC molecules can be manufactured by existing, standard methods.** Our GalXC molecules consist of RNA oligonucleotides, which can be manufactured with well-understood chemistries on existing readily available equipment. Such equipment is available, at various manufacturing scales, in multiple contract manufacturing organizations with good manufacturing practice capabilities. We believe this reduces the risks associated with commercial manufacturing of our candidates.
- **Unlike gene therapy and gene editing, our GalXC RNAi therapy is fully reversible.**

Development Approach

In choosing which development programs to internally advance, we apply the scientific, clinical, and commercial criteria listed below that we believe allow us to best leverage our GalXC RNAi platform and maximize value. We believe that our current development programs meet many or all of these criteria:

- **Strength of therapeutic hypothesis.** We seek to target genes with a therapeutic intervention that are likely to have substantial benefit for the patient.
- **Readily-identified patient population.** We seek disease indications where patients can be readily identified by the presence of characteristic genetic mutations or other readily-accessible disease features. In the case of genetic diseases, these are heritable genetic mutations that can be identified with available routine genetic tests.
- **Predictivity of biomarkers for early efficacy assessment.** We seek these markers to allow us to determine in early stages of clinical development whether our GalXC molecules are likely to have the expected biological and clinical effects in patients.
- **High unmet medical need.** We seek to provide patients with significant benefit and alleviation of disease. The indications we choose to approach have high unmet medical need, which is intended to enable us to better access patients and qualify for pricing and reimbursement that justify our development efforts.
- **Rapid development path to proof-of-concept or approval.** We seek indications with the potential for rapid development to proof-of-concept or marketing approval in order to reach commercialization expeditiously and to help ensure our ability to finance development of our product candidates. When appropriate, we will seek breakthrough therapy designation from the United States ("U.S.") Food and Drug Administration ("FDA").

The Dicerna Pipeline

Using our GalXC RNAi technology, and applying the criteria of our development focus, we have created a pipeline of core therapeutic programs for development by Dicerna. For opportunities that were not selected as a core program opportunity, we have

sought partners to fund the discovery, and subsequently drive the development of, these non-core opportunities in exchange for upfront payments, milestone payments, royalties on product sales, and potentially other economic and operational arrangements. Our current collaborations with Novo, Lilly, Alexion, and BI resulted from this effort. For core programs targeting rare diseases, we intend to develop these programs internally through approval. For core programs targeting larger populations, we may seek collaborative partners, such as our collaboration with Roche on RG6346, under various economic and operational arrangements. Together, our core program pipeline and our pipeline of non-core collaborative programs constitute a broad and growing therapeutic pipeline that we believe may result in multiple valuable approved products based on our GalXC technology.

In addition to the programs listed in our pipeline, we are exploring a variety of potential programs involving gene targets in the liver, CNS, and other tissues, which we may elevate in the future to be either core programs or non-core collaborative programs. Under our collaborations with Novo, Lilly, and Roche, our collaborators have rights to nominate additional programs for discovery by Dicerna and subsequent development by the nominating collaborator, and which will become part of our non-core pipeline.

The tables below set forth the state of development of our various GalXC RNAi platform product candidates as of February 27, 2020.

CANDIDATE	INDICATION	RESEARCH	PRECLINICAL	CLINICAL POC TRIALS	REGISTRATION TRIALS	PARTNER
Nedosiran (DCR-PHXC)	Primary Hyperoxaluria					—
RG6346 (DCR-HBVS)	Hepatitis B Virus					Roche
DCR-A1AT	A1AT Liver Disease					—
DCR-undisclosed	Undisclosed					—

CANDIDATE	INDICATION	RESEARCH	PRECLINICAL	CLINICAL POC TRIALS	REGISTRATION TRIALS	PARTNER
DCR-LIV2	NASH					Boehringer Ingelheim
LY3561774*	Cardiometabolic					Lilly
DCR-CM2	Cardiometabolic					Lilly
DCR-CM4	Cardiometabolic					Lilly
DCR-CM5	Cardiometabolic/non-liver					Lilly
DCR-NEURO1	Neurodegeneration					Lilly
DCR-NEURO2	Neurodegeneration					Lilly
DCR-LLY9	Undisclosed					Lilly
DCR-PAIN1	Pain					Lilly
DCR-PAIN2	Pain					Lilly
DCR-COMP1	Complement-mediated					Alexion
DCR-COMP2	Complement-mediated					Alexion
DCR-COMP3	Complement-mediated					Alexion
DCR-COMP4	Complement-mediated					Alexion

** Formerly DCR-CM1*

ORPHAN PREVALENT

Nedosiran for Primary Hyperoxaluria

We are developing our lead GalXC product candidate, nedosiran, for the treatment of PH1, PH2, and PH3. Nedosiran is in the pivotal phase of clinical development. PH is a family of severe, ultra-rare, genetic liver disorders characterized by the overproduction of oxalate, a highly insoluble metabolic end-product that is eliminated from the body mainly by the kidneys. In patients with PH, the kidneys are unable to eliminate fully the large amount of oxalate that is produced. This accumulation of oxalate compromises the renal system, which may result in severe damage to the kidneys and other organs.

PH encompasses three genetically distinct, autosomal-recessive, inborn errors of glyoxylate metabolism characterized by the overproduction of oxalate. PH1, PH2, and PH3 are each characterized by a specific enzyme deficiency. PH1 is caused by a deficiency of glyoxylate-aminotransferase, PH2 is caused by a deficiency of glyoxylate reductase/hydroxypyruvate reductase, and PH3 is caused by a deficiency of 4-hydroxy-2-oxoglutarate aldolase. Patients with PH are predisposed to the development of recurrent urinary tract (urolithiasis) and kidney (nephrolithiasis) stones, composed of calcium oxalate crystals. Stone formation is accompanied by nephrocalcinosis in some patients with PH1 and PH2. This deposition of calcium oxalate crystals in the renal parenchyma produces tubular toxicity and renal damage that is compounded by the effects of renal calculi-related obstruction and frequent superimposed infections. Based on evaluation of genome sequence databases, there may be as many as 16,000 people with PH in the U.S. and major European countries.

Most patients are diagnosed with PH in childhood or early adulthood. At present, no therapies are approved by regulatory authorities for the treatment of patients with PH. A number of supportive therapies are used in an attempt to mitigate some effects of the disease. Current medical management, before renal failure develops, is underpinned by hyperhydration recommendations of at least three liters of fluid per day per square meter of body-surface area (5 L/day for a 70-kg adult). These regimens can be problematic in infants and toddlers, necessitating placement of a gastrostomy tube to ensure adequate nighttime fluid administration. Affected patients are at considerable risk of serious renal complications during periods of increased fluid loss (fever, diarrhea/vomiting, and urinary tract infections) or when oral hydration is compromised (following surgical procedures). Oral potassium citrate administration multiple times daily is used to potentially alleviate crystallization and alkalinize the urine. In PH1, between 10-30% of patients are responsive (i.e., greater than 30% reduction of urinary oxalate) to high daily administration of pyridoxine (vitamin B6), but only rarely do these patients reach normal or near-normal urinary oxalate levels.

For PH1 and PH2 patients with more advanced disease, dialysis may be used in an attempt to remove stored and concurrent overproduction of oxalate. In contrast to the typical three times weekly hemodialysis regimens used in other types of renal failure, patients with PH may require hemodialysis six or seven days per week. This intensive regimen may still not be able to keep up with the endogenous oxalate production. Given the limitations of dialysis and the inability to impact oxalate overproduction substantially in most patients with PH1, most centers now consider liver transplantation approaches earlier in the disease course to minimize the risk of irreversible tissue damage. Current treatments may include sequential or combined liver-kidney transplantation. As with organ transplantation in other diseases, these procedures are associated with significant medical risk and a requirement for long-term treatment with immunosuppressive drugs that are also associated with significant side effects. We believe this level of unmet need provides a strong rationale for our initial focus on the treatment of PH.

Our GalXC-containing nedosiran product candidate seeks to block production of the lactate dehydrogenase A enzyme by silencing the *LDHA* gene. PH is characterized by overproduction of oxalate in the liver. The last step in the production of oxalate in the liver involves the *LDHA* gene, making *LDHA* silencing a potentially highly promising approach to the treatment of PH1, PH2, and PH3. In preclinical studies of PH1 and PH2 animal models, we have observed a near-linear correlation between *LDHA* silencing and oxalate reduction. In addition, *LDHA* silencing in the liver appears to be a minimal metabolic intervention, as it does not cause measurable changes to known blood and urinary biomarkers of metabolic activity. There are numerous case reports of *LDHA* deficiency naturally occurring in humans, with no reported adverse effects due to deficiency in the liver. For these reasons among others, we believe that *LDHA* silencing is an ideal approach to blocking oxalate over-production in PH1, PH2, and PH3.

In May 2018, we received notice from the FDA granting Orphan Drug Designation to nedosiran for the treatment of PH. In August 2018, the European Medicines Agency (“EMA”)’s Committee for Orphan Medicinal Products (“COMP”) designated nedosiran as an orphan medicinal product for the treatment of PH in the European Union (“EU”).

As of November 2019, we completed all study participant dosing and follow-up in PHYOX™1, a Phase 1 single-ascending-dose study of nedosiran in healthy volunteers and study participants with PH1 and PH2. The primary objective of the study was to evaluate the safety, tolerability, pharmacokinetics, and pharmacodynamics of single-ascending doses of nedosiran. Secondary endpoints included the change in 24-hour urinary oxalate excretion from baseline, defined as the mean of two 24-hour collections during screening. The trial was divided into two groups:

- Group A was a placebo-controlled, single-blind study and included 25 healthy volunteers at a single site in the United Kingdom with five cohorts dosed at 0.3, 1.5, 3.0, 6.0, or 12.0 mg/kg of nedosiran or placebo (3:2 randomization).

- Group B was an open-label study and included 18 participants, 15 with PH1 and three with PH2, and included three cohorts of participants dosed at 1.5, 3.0, and 6.0 mg/kg of nedosiran and a fourth cohort with mixed dosing. Group B participants were enrolled among three sites in the European Union, one in the United Kingdom, and one site in the United States.

Group A dosing was completed in March 2018, and Group B dosing was completed in January 2019. We first reported interim results from the PHYOX1 trial on September 5, 2018 and subsequently presented updated results at the American Society of Nephrology's ("ASN") Kidney Week in San Diego on October 25, 2018, at the German Society of Pediatric Nephrology 50th Annual Meeting in Cologne, Germany on March 28, 2019, at the Oxalosis and Hyperoxaluria Foundation International Hyperoxaluria Workshop in Boston, Massachusetts on June 20, 2019, and at the ASN's Kidney Week Annual Meeting in Washington, D.C. on November 7, 2019.

With respect to efficacy data in PHYOX1, as of September 2019, nedosiran was associated with normalization or near-normalization of urinary oxalate levels in 14 of 18 adult patients with PH1 and PH2 following single-dose administration.

The PHYOX1 investigators also reported that the three participants with PH2 (one of whom received a single 1.5 mg/kg dose of nedosiran; the other two received a 3.0 mg/kg dose) achieved a mean maximal reduction of 24-hour urinary oxalate of 49% (range: 39% to 66%) with one participant reaching normalization and another participant reaching near-normalization at one or more post-dose time points. The PH2 patient that did not achieve normalization or near-normalization was dosed at the 1.5 mg/kg level.

Preliminary data from the PHYOX1 trial presented in November 2019 showed that nedosiran was well tolerated based on data from 18 participants (15 adults and three adolescents [participants 13-16 years old]) with PH1 (n=15) and PH2 (n=3) and 25 adult healthy volunteers. To date, seven serious adverse events ("SAEs") have occurred in six participants in Group B; none was deemed related to the study drug, and all seven SAEs have resolved. A total of seven participants dosed with nedosiran experienced mild or moderate injection-site reactions, all of which resolved without intervention in a mean of 25 hours. No clinically meaningful safety signals were observed, including from liver function tests.

We received approval to proceed with the Phase 2 ("PHYOX2") and Phase 3 ("PHYOX3") studies in 2019 in a subset of the countries in which we intend to open trial sites. We initiated dosing of participants rolling over from the PHYOX1 trial into the recently approved PHYOX3 study, a long-term, multi-dose, open-label, roll-over extension study. We expect initial multi-dose data from this trial to be available in March 2020. Additionally, we are currently enrolling patients in our registration trial, PHYOX2, for which enrollment is expected to be completed by the end of the first half of 2020. The last patient visit in the PHYOX2 trial is expected by the end of 2020. In addition to the PHYOX2 clinical trial, we have multiple additional trials planned. In the first half of 2020, further clinical studies will be initiated in patients with PH3 (PHYOX4) and in PH1 and PH2 patients with severe renal impairment, including those in dialysis (PHYOX7), pending regulatory approvals. A study in PH1 and PH2 patients aged 2-5 years, with relatively intact renal function (PHYOX8), is planned for the second half of 2020, pending regulatory approvals.

In discussions with the FDA, we received feedback indicating alignment on a path to the full approval of nedosiran for the treatment of PH1 and PH2 based on achievement of substantial reduction of high baseline urinary oxalate in patients with PH1 and PH2 in the PHYOX2 pivotal trial. With this feedback, we believe we have a path to seek full approval in both PH1 and PH2 based on PHYOX2 results. In July 2019, we received Breakthrough Therapy Designation from the FDA for the development of nedosiran for the treatment of PH1. We plan to continue our dialogue with the FDA regarding endpoints for studies involving patients with PH3 as part of the PHYOX clinical development program for nedosiran and potentially an expansion of the Breakthrough Therapy Designation to include PH2.

The ultimate goal of any PH therapy is for patients to live a normal life without the need to comply with hyperhydration and urine alkalization supporting therapies in order to prevent the formation of new calcium oxalate crystals. The PHYOX3 study will evaluate nedosiran's long-term effect in reducing urinary oxalate levels to the normal range, enabling patients' supportive therapies to be gradually decreased or eliminated. To best achieve this ultimate goal, Dicerna has developed a once-monthly fixed-dose injection regimen of nedosiran. This once-monthly formulation of nedosiran is designed to avoid the sudden oxalate spikes that could occur with less frequent administration or missed dosages and which could result in the formation of kidney stones and renal failure. To maximize patient convenience, we are developing pre-filled syringes to enable self-administration by most PH patients without the need for involvement of a healthcare provider.

RG6346 for Chronic Hepatitis B Virus Infection

Our GalXC RNAi platform-based product candidate for the treatment of chronic HBV infection, RG6346, is currently being tested in a Phase 1 clinical trial. HBV is reported to be the most common serious liver infection affecting an estimated 292 million people globally. Chronic HBV is characterized by the presence of the hepatitis B surface antigen ("HBsAg") for six months or more.

Current therapies for HBV include nucleoside analogs ("NUCs") and pegylated interferon regimens. Interferons are less effective at suppressing viral replication and are associated with several side effects. NUCs are relatively safe to use but usually require indefinite therapy that increases the risk of non-adherence. Furthermore, the vast majority of patients treated with these agents do not achieve an immunological cure of chronic HBV infection as defined by the sustained clearance of HBsAg and HBV deoxyribonucleic acid ("DNA") suppression in patient blood or serum. The chance of achieving a long-term immunological cure may be significantly enhanced with the introduction of novel drugs, such as RG6346, designed to reduce intrahepatic and serum HBsAg, as well as HBV DNA. These novel drugs may be used in combination with each other and existing therapies, such as NUCs.

RG6346 targets HBV messenger RNA and has shown a greater than 99.9% reduction in circulated HBsAg in mouse models of HBV infection. We are evaluating the potential of RG6346 to reduce HBsAg expression and HBV DNA in HBV patients in a subcutaneous dosing paradigm in a Phase 1 clinical trial. We received Clinical Trial Application ("CTA") and ethics committee approvals for this trial in healthy volunteers and patients with chronic HBV infection in New Zealand in December 2018 and in Australia, Hong Kong, South Korea, and Thailand in 2019. The Phase 1 study was initiated in December 2018 and the first participants were dosed in January 2019. We anticipate human proof-of-concept data from the existing cohorts of our RG6346 Phase 1 clinical trial to be available in the third quarter of 2020.

The DCR-HBVS-101 clinical trial is a Phase 1 randomized, placebo-controlled, double-blind study designed to evaluate the safety and tolerability of RG6346 in healthy volunteers and in patients with non-cirrhotic chronic HBV. Secondary objectives are to characterize the pharmacokinetic profile of RG6346 and to evaluate preliminary antiviral efficacy, as well as characterize the pharmacodynamics of RG6346 on HBsAg and HBV DNA levels in blood. The DCR-HBVS-101 clinical trial is divided into three phases or groups:

- Group A is a single-ascending-dose arm in which 30 healthy volunteers received a dose of RG6346 (0.1, 1.5, 3.0, 6.0, or 12.0 mg/kg) or placebo, with a four-week follow-up period. Group A dosing was completed in August 2019.
- Group B is a single-dose arm in which eight participants with chronic HBV who are naïve to NUC therapy receive a 3.0 mg/kg dose of RG6346 or placebo; these participants will be followed for at least 12 weeks. We initiated Group B dosing in the third quarter of 2019, in parallel with Group C at the 3.0 mg/kg dose level. Group B dosing is expected to be completed in the first quarter of 2020.
- Group C is a multiple-ascending-dose arm in which RG6346 (1.5, 3.0, or 6.0 mg/kg) or placebo will be administered to 18 participants with chronic HBV who are already being treated with NUCs, with a treatment and follow-up period of 16 weeks or more.
    - We dosed the first patient, from Group C, at a dose of 1.5 mg/kg, in May 2019. The final patient's last dose in the 1.5 mg/kg dose group was administered in October 2019.
    - We dosed the first patient in 3.0 mg/kg cohort in August 2019. The final patient's last dose in the 3.0 mg/kg dose group was administered in January 2020.
    - We dosed the first patient in the 6.0 mg/kg cohort in December 2019 and are enrolling the remainder of the cohort.

Participants with chronic HBV in Groups B and C, in whom HBsAg will have dropped equal to or more than 1 log10 IU/mL below their baseline at the time of their last scheduled study visit, will continue to be followed until their HBsAg level is less than 1 log10 IU/mL below their baseline value. Multiple patients had achieved this level of HBsAg reduction at their last scheduled visit.

In order to facilitate development and potential commercialization of our product candidate, RG6346, in combination with other novel drugs, we entered into a research collaboration and licensing agreement with Roche in October 2019. Under the terms of the agreement, we will be leading the development of RG6346 through the current Phase 1 trial, and pending favorable results, Roche intends to further develop RG6346 with the overall goal of developing a combination regimen to achieve a long-term immunological cure of chronic HBV in combination with additional Roche product candidates in Phase 2 and Phase 3 clinical trials.

DCR-A1AT for Alpha-1 Antitrypsin Deficiency-Associated Liver Disease

Our GalXC RNAi platform-based product candidate for the treatment of A1AT deficiency-associated liver disease, DCR-A1AT, is currently being tested in a Phase 1/2 clinical study. A1AT deficiency is an inherited disorder that can lead to liver disease in children and adults and lung disease in adults. The disorder is caused by mutations in a gene called *SERPINA1*. This gene, when functioning normally, provides instructions for making the A1AT protein, which protects the body from an enzyme called neutrophil elastase. This enzyme is released from white blood cells to fight infection, but it can attack normal tissues if not tightly controlled by A1AT. Mutations in the *SERPINA1* gene can result in a deficiency of A1AT or, most commonly, an abnormal form of the protein that cannot control neutrophil elastase. Accumulation of abnormal A1AT protein in the liver can lead to liver disease. Uncontrolled neutrophil elastase can also destroy alveoli (small air sacs in the lungs) and cause lung disease.

Approximately 7% of children with A1AT deficiency who develop liver disease develop cirrhosis, and over 15% require liver transplantation. About 10% of adults with A1AT deficiency who develop liver disease develop cirrhosis due to formation of scar tissue in the liver, and over 15% of those require liver transplantation. Individuals affected by A1AT deficiency are also at risk of developing hepatocellular carcinoma, a type of liver cancer. Liver transplantation is currently the only effective treatment for A1AT deficiency-associated liver disease.

A1AT deficiency occurs all over the world, though its prevalence varies by population. The disorder affects roughly one in 1,500 to 3,500 individuals with European ancestry but is uncommon in people of Asian descent. Congenital A1AT deficiency is estimated to affect 2.4 people out of every 10,000 in the EU. It is estimated that less than 10% of individuals with A1AT deficiency are diagnosed. The diagnosis of A1AT-associated liver or lung disease is a diagnosis of exclusion, as no specific clinical diagnostic criteria exist for these diseases. Therefore, according to the Journal of the Chronic Obstructive Pulmonary Disease Foundation Clinical Practice Guidelines, all individuals with chronic obstructive pulmonary disease should be tested for A1AT deficiency, and all individuals with unexplained chronic liver disease should be tested for A1AT deficiency as well. Nevertheless, even in symptomatic patients, the correct diagnosis is often delayed by many years.

In December 2019, the European Commission granted orphan drug designation to DCR-A1AT for the treatment of congenital A1AT deficiency based on a positive opinion from the COMP of the EMA. We submitted a CTA to the Swedish Medical Products Agency in June 2019 to conduct a first-in-human Phase 1/2 study of DCR-A1AT, an investigational therapy from our GalXC™ technology platform. We expect dosing of the first patient in this Phase 1/2 study, named ESTRELLA, to occur in the second half of 2020.

The initial DCR-A1AT-101 clinical trial is a Phase 1/2 randomized, placebo-controlled study designed to evaluate the safety and tolerability of DCR-A1AT in healthy volunteers and in patients with A1AT deficiency-associated liver disease. Secondary objectives are to characterize the pharmacokinetic profile of DCR-A1AT, to evaluate preliminary pharmacodynamics on serum A1AT protein concentrations, and to characterize the effect of DCR-A1AT on A1AT deficiency-associated liver disease evaluated by liver biopsy. Exploratory objectives include characterization of the effect of DCR-A1AT on A1AT deficiency-associated liver disease evaluated by biochemical markers as well as the effect on liver stiffness. The DCR-A1AT-101 clinical trial is divided into two phases or groups:

- Group A is a single-ascending-dose arm in which a single dose of DCR-A1AT (0.1, 1.0, 3.0, 6.0, or 12.0 mg/kg) or placebo will be administered to up to 36 healthy volunteers, with a minimum 8-week follow-up. The first participant in Group A was dosed in November 2019; we expect dosing of Group A to be completed in the second half of 2020.
- Group B is a multiple-ascending-dose arm in which DCR-A1AT (doses yet to be determined) or placebo will be administered to up to 24 participants with A1AT with a treatment and follow-up period of 12 weeks or more.

DCR-Undisclosed

We are currently pursuing preclinical development of an undisclosed candidate for the treatment of a common disease involving the liver. We expect to begin a Phase 1 study for this program in 2021.

Partner Development Programs

Novo Collaboration

On November 15, 2019, we entered into a Collaboration and License Agreement with Novo (the “Novo Collaboration Agreement”). Under the terms of the Novo Collaboration Agreement, we and Novo will seek to use Dicerna’s proprietary GalXC™ RNAi platform technology to progress novel therapies for the treatment of liver-related cardiometabolic diseases towards clinical development and commercialization. Under the Novo Collaboration Agreement, we and Novo plan to explore more than 30 gene targets associated with liver disease with the goal of delivering multiple clinical candidates for disorders including chronic liver disease, non-alcoholic steatohepatitis (“NASH”), type 2 diabetes, obesity, and rare diseases. We will conduct and fund discovery and preclinical development to clinical candidate selection for each liver cell target. Novo will be responsible for all further development and commercialization, with Dicerna manufacturing clinical candidates selected for Phase-1-related clinical development, subject to reimbursement for its manufacturing costs. We also retain the ability to opt in to co-development of two programs during clinical development in Phases 1-3, subject to limitations in the event of a change in control of the Company. If we exercise the co-development option, we also have an option to co-promote the products in the United States, subject to limitations in the event of a change of control. Additionally, we may lead the development and commercialization of two programs targeting orphan liver diseases, with Novo retaining the ability to opt in to both programs in Phases 1-3. We and Novo will share profit and loss for the Company’s orphan liver and Novo products should both parties elect to co-develop.

The Novo Collaboration Agreement provides that we will work exclusively with Novo during the research collaboration period on the discovery, research, development, and commercialization of hepatocyte targets not otherwise subject to our existing partnerships and that Novo will, during a specified discovery period, work exclusively with Dicerna in any new research and development of compounds and products directed to collaboration targets using small interfering RNA ("siRNA") conjugated to the sugar GalNAc to reduce the expression of specific target genes in the liver. Under the Novo Collaboration Agreement, we will provide Novo with exclusive and non-exclusive licenses and manufacturing support to enable Novo to commercialize products derived from or containing compounds developed pursuant to such agreement.

Under the terms of the Novo Collaboration Agreement, Novo paid us a non-refundable upfront payment of $175.0 million in January 2020. Also, in December 2019, Novo made a $50.0 million equity investment in Dicerna at a premium pursuant to a share issuance agreement between the parties (the "Novo Share Issuance Agreement"). We are also eligible to receive an additional $75.0 million ($25.0 million at the end of each of the first three years of the Novo Collaboration Agreement), contingent upon us delivering GalXC™ molecules for a defined number of targets, and additional payments totaling up to $357.5 million per target upon achievement of specified development, regulatory, and commercial milestones. In addition, the Novo Collaboration Agreement provides that Novo will pay us mid-single-digits to mid-teens royalties on product sales on a country-by-country and product-by-product basis until the later of 10 years after the date of first commercial sale of each product in such country, expiration of specified patent rights in such country, or the expiration of specified regulatory exclusivity in such country for GalXC products, subject to royalty step-down provisions set forth in the agreement.

Roche Collaboration

On October 30, 2019, we entered into a Collaboration and License Agreement with Roche (the "Roche Collaboration Agreement"). Under the terms of the Roche Collaboration Agreement, we and Roche will seek to progress RG6346, our investigational therapy in Phase 1 clinical development, toward worldwide development and commercialization. The Roche Collaboration Agreement also provides an option for the companies to collaborate in the discovery, development, and commercialization of oligonucleotide therapeutics intended for the treatment of HBV infection.

The Roche Collaboration Agreement requires that we complete the ongoing Phase 1 clinical trial, along with additional Phase 1 cohorts upon the request of Roche, who will reimburse us for the cost of the additional cohorts, after which Roche will lead the development and commercialization of the RG6346 program. Roche also has until receipt of interim Phase 1 data from the RG6346 Phase 1 study (but no later than December 31, 2020) to initiate a research and development collaboration with us to pursue up to five targets selected by Roche, which are intended primarily to treat HBV. Under the terms of the Roche Collaboration Agreement, the goal of such research and development will be to select compounds developed by us or Roche for Roche's continued development and commercialization. The Roche Collaboration Agreement provides that we and Roche's research and early development organization will work exclusively with each other during the research and development collaboration period on the discovery, research, and development of such targets selected by Roche, which includes our performance of certain services. Under the Roche Collaboration Agreement, we will provide Roche with exclusive and non-exclusive licenses to support Roche's activities and to enable Roche to commercialize products derived from or containing compounds developed pursuant to such agreement.

Under the terms of the Roche Collaboration Agreement, Roche paid us a non-refundable upfront payment of $200.0 million in January 2020. We are also eligible to receive additional payments totaling up to approximately $1.47 billion, which includes payments upon achievement of specified development, regulatory, and commercial milestones. In addition, the Roche Collaboration Agreement provides that Roche will pay us up to mid-teens percent royalties on product sales. Royalties are payable until the later of 10 years after first commercial sale of each product in a country, expiration of patent rights in a country, or for products containing RG6346 in a given country, the expiration of data or regulatory exclusivity, subject to certain royalty step-down provisions set forth in the agreement. In addition, we have an option to co-fund the development of products including RG6346 under the agreement and, if exercised, receive high-twenties to mid-thirties royalty rates on the net sales of products in the U.S. If we exercise the co-funding option, we also have an option to co-promote products containing RG6346 in the U.S.

Lilly Collaboration

On October 25, 2018, we entered into a Collaboration and License Agreement with Lilly (the "Lilly Collaboration Agreement"). The Lilly Collaboration Agreement is for the discovery, development, and commercialization of potential new medicines in the areas of cardiometabolic disease, neurodegeneration, and pain. Under the terms of the Lilly Collaboration Agreement, we and Lilly will seek to use our proprietary GalXC RNAi technology platform to progress new drug targets toward clinical development and commercialization. In addition, we will collaborate with Lilly to extend the GalXC RNAi platform technology to non-liver tissues, including neural tissues.

The Lilly Collaboration Agreement provides that we will work exclusively with Lilly in the neurodegeneration and pain fields with the exception of mutually agreed upon orphan indications. Additionally, we will work exclusively with Lilly on select targets in

the cardiometabolic field. Under the Lilly Collaboration Agreement, we will provide Lilly with exclusive and non-exclusive licenses to support the companies' activities and to enable Lilly to commercialize products derived from or containing compounds developed pursuant to such agreement. The Lilly Collaboration Agreement contemplates in excess of 10 targets.

Under the terms of the Lilly Collaboration Agreement, Lilly paid us a non-refundable upfront payment of $100.0 million, and made a concurrent $100.0 million equity investment in Dicerna at a premium pursuant to a share issuance agreement between the parties (the "Lilly Share Issuance Agreement"). Under the Lilly Collaboration Agreement, we are also eligible to potentially receive up to approximately $350.0 million per target in development and commercialization milestones, in addition to a $5.0 million payment due for each of the non-hepatocyte targets when a product achieves proof of principle in an animal model. In addition, the Lilly Collaboration Agreement also provides that Lilly will pay us mid-single to low-double-digit royalties on product sales on a country-by-country and product-by-product basis until the later of expiration of patent rights in a country, the expiration of data or regulatory exclusivity in such country, or 10 years after the first product sale in such country, subject to certain royalty step-down provisions set forth in the agreement.

We expect Lilly to submit an Investigational New Drug ("IND") application or CTA filing for the first GalXC molecule being developed under the Lilly Collaboration Agreement, LY3561774, in late 2020.

Alexion Collaboration

On October 22, 2018, we entered into a Collaborative Research and License Agreement (the "Alexion Collaboration Agreement") with Alexion for the joint discovery and development of RNAi therapies for complement-mediated diseases. Under the terms of the Alexion Collaboration Agreement, we will collaborate with Alexion on the discovery and development of GalXC candidates for the treatment of complement-mediated diseases with potential global commercialization by Alexion. We will lead the joint discovery and research efforts through the preclinical stage, and Alexion will lead development efforts beginning with Phase 1 studies. We will be responsible for manufacturing of the GalXC candidates for use through the completion of Phase 1, the costs of which, after an initial cost-sharing period, will be paid by Alexion. Alexion will generally be responsible for the manufacturing of any product candidate subsequent to the completion of Phase 1.

Under the terms of the Alexion Collaboration Agreement, Alexion paid us a non-refundable upfront payment of $22.0 million, with Alexion Pharmaceuticals making a concurrent $15.0 million equity investment in Dicerna at a premium pursuant to a share issuance agreement between us and Alexion Pharmaceuticals (the "Alexion Share Issuance Agreement"). The Alexion Collaboration Agreement also provides for potential additional payments to Dicerna of up to $600.0 million from proceeds from target option exercises and development and sales milestones, as defined in the agreement, which includes option exercise fees of up to $20.0 million, representing $10.0 million for each of the additional candidates selected; development milestones of up to $105.0 million for each product; and aggregate sales milestones of up to $160.0 million. Under the agreement, Alexion will also pay us mid-single to low-double-digit royalties on potential product sales on a country-by-country, product-by-product basis until the later of the expiration of patent rights in a country, the expiration of market or regulatory exclusivity in such country, or 10 years after the first product sale in such country, subject to certain royalty step-down provisions set forth in the agreement.

In November 2019, the Company and Alexion amended the Alexion Collaboration Agreement to clarify funding of certain manufacturing costs for each of the two initial targets and increased milestone payments for the additional targets if Alexion exercised its options for the two additional targets.

In December 2019, Alexion exercised its options for the exclusive rights to two additional targets within the complement pathway for the discovery and development of GalXC™ RNAi molecules. These exercises expand the companies' existing research collaboration and license agreement to now encompass four targets within the complement pathway, and provide Alexion with exclusive worldwide licenses, as well as development and commercial rights to the GalXC RNAi molecules developed in the collaboration. In connection with the option exercises, Alexion paid Dicerna a total of $20.0 million, or $10.0 million in option exercise fees per additional new target that will be recognized into revenue as the related services are performed.

BI Collaboration

On October 27, 2017, we entered into a Collaborative Research and License Agreement with BI (the "BI Agreement"), pursuant to which we and BI agreed to jointly research and develop product candidates for the treatment of chronic liver diseases, with an initial focus on nonalcoholic steatohepatitis ("NASH") using our GalXC platform. NASH is caused by the buildup of fat in the liver, potentially leading to liver fibrosis and cirrhosis. NASH has an especially high prevalence among obese and diabetic patients and is an area of high unmet medical need.

The BI Agreement is for the development of product candidates against one target gene with an option for BI to add the development of product candidates that target a second gene (the "Second Target"). We are responsible for the discovery and initial

profiling, including primary preclinical studies, synthesis, and delivery of the product candidates. BI is responsible for evaluating and selecting the product candidates for further development. If BI selects one or more product candidates, it will be responsible for further preclinical development, clinical development, manufacturing, and commercialization of those products. Also pursuant to the BI Agreement, we granted BI a worldwide license in connection with the research and development of the product candidates and have transferred to BI certain intellectual property rights of the product candidates selected by BI for clinical development and commercialization. We also may provide assistance to BI in order to help BI further develop selected product candidates.

Under the terms of the BI Agreement, BI agreed to pay us a non-refundable upfront payment of $10.0 million for the first target. During the term of the research program, BI will reimburse Dicerna the cost of materials and third-party expenses that have been included in the preclinical studies up to an agreed-upon limit. We are eligible to receive up to $191.0 million in potential development and commercial milestones related to the initial target. We are also eligible to receive royalty payments tiered from high single digits up to low double-digits on potential net sales on a country-by-country (or territory-by-territory), product-by-product basis until the later of the expiration of the last to expire valid claim of any product patent right covering the composition of matter of such product or 10 years after the first product sale in such country or territory, subject to certain royalty step-down provisions set forth in the agreement. BI's Second Target option provided for an option fee payment of $5.0 million and success-based development and commercialization milestones and royalty payments to Dicerna.

In October 2018, BI exercised its Second Target option, which entitled the Company to a non-refundable payment of $5.0 million and reimbursement of $0.7 million for certain third-party expenses upon the agreement of a research work plan and budget for the Second Target. The terms of the Second Target option exercise and related rights and obligations associated with the Second Target were agreed between the Company and BI in an Additional Target Agreement (the "ATA"), which was entered into on December 31, 2018. Under the terms of the ATA, during the term of the research program, BI will reimburse us for certain expenses. We are eligible to receive up to $170.0 million in potential development and commercial milestones related to the Second Target. We are also eligible to receive tiered royalty payments on potential global net sales, subject to certain adjustments, in the mid-single digits. Other than as set forth in the ATA, development of the Second Target will be subject to the terms of the BI Agreement.

In addition to establishing the terms of the Second Target option exercise, the ATA also amends the BI Agreement to provide the parties with the opportunity to consider the development of product candidates targeting a further additional target gene (the "Third Target" option).

Intellectual Property

We are seeking multifaceted and multi-layered protection for our intellectual property on a global level that includes licenses, confidentiality and non-disclosure agreements, copyrights, patents, trademarks, and trade secrets. We enter into confidentiality and proprietary rights agreements with our employees, consultants, collaborators, subcontractors, and other third parties and generally seek to control access to our documentation and proprietary information as well as ownership to nascent intellectual property.

Patents and proprietary rights

We own U.S. patents and pending patent applications with claims to methods and compositions of matter that cover various aspects of our RNAi technology and our discovery technologies, including our proprietary GalXC technology. These U.S. patents include the following platform patents that protect our ability to make our structures: U.S. 8,349,809 (issued in January 2013, with a projected expiration date of January 2030); U.S. 8,513,207 (issued in August 2013, with a projected expiration date of May 2030); and U.S. 8,927,705 (issued in January 2015, with a projected expiration date of July 2030). These patents are from the same family of patents and constitute the core patents for our GalXC technology. We also own numerous patents and patent applications covering specific RNAi sequences that drive activity against a substantial number of high-value disease targets, including targets for our disclosed core and non-core programs. We have issued or pending claims to RNAi molecules, pharmaceutical compositions/formulations, methods of use, including *in vitro* and *in vivo* methods of reducing target gene expression, methods of treatment, methods of inhibiting cell growth, and methods of synthesis.

Our strategy around protection of our proprietary technology, including any innovations and improvements, is to obtain patent coverage in various jurisdictions around the world with a focus on jurisdictions that represent significant global pharmaceutical markets. Generally, patents have a term of 20 years from the earliest non-provisional priority date, assuming that all maintenance fees are paid, no portion of the patent has been terminally disclaimed, and the patent in question has not been invalidated by a court with proper jurisdiction. In certain jurisdictions, and in certain circumstances, patent terms can be extended or shortened. We are obtaining worldwide patent protection for novel molecules, composition of matter, pharmaceutical formulations, methods of use, including treatment of disease, methods of manufacture, and other novel uses for the inventive molecules originating from our research and development efforts, and other things. We continuously assess whether it is strategically more favorable to maintain confidentiality for the "know-how" regarding a novel invention or the trade secrets that may be inherent in a given process or method rather than pursue

patent protection. For each patent application that is filed, we strategically tailor our claims in accordance with the existing patent landscape around a particular patentable matter.

We cannot predict with any certainty if any third-party U.S. or foreign patent rights, or other proprietary rights, will be deemed infringed by the use of our technology. Nor can we predict with certainty which, if any, of these rights will or may be asserted against us by third parties. Should we need to defend ourselves and our collaborators against any such claims, substantial costs may be incurred. Furthermore, parties making such claims may be able to obtain injunctive or other equitable relief, which could effectively block our ability to develop or commercialize some or all of our products in the U.S. and abroad and could result in the award of substantial damages. In the event of a claim of infringement, we or our collaborators may be required to obtain one or more licenses from a third party. There can be no assurance that we can obtain a license on a reasonable basis should we deem it necessary to obtain rights to an alternative technology that meets our needs. The failure to obtain a license may have a material adverse effect on our business, results of operations, and financial condition.

We also rely on trade secret protection for our confidential and proprietary information. No assurance can be given that we can meaningfully protect our trade secrets on a continuing basis. Others may independently develop substantially equivalent confidential and proprietary information or otherwise gain access to our trade secrets.

It is our policy to require our employees and consultants, outside scientific collaborators, sponsored researchers, and other advisors who receive confidential information from us, to execute confidentiality agreements upon the commencement of employment or consulting relationships. These agreements provide that all confidential information developed or made known to these individuals during the course of the individual's relationship with us is to be kept confidential and is not to be disclosed to third parties except in specific circumstances. The agreements provide that all inventions conceived by an employee shall be our property, except that employees are permitted to invent in unrelated fields during non-work hours, and such inventions would not be our property. There can be no assurance, however, that these agreements will provide meaningful protection or adequate remedies for our trade secrets in the event of unauthorized use or disclosure of such information.

See Item 1A – "Risk Factors – Risks Related to Intellectual Property" for a more detailed discussion of the risks to our intellectual property.

Competition

To our knowledge, there are no companies other than ourselves and our collaborators developing GalXC molecules for therapeutic use. We believe that our scientific knowledge and expertise in RNAi-based therapies provide us with competitive advantages over the various companies and other entities that are attempting to develop similar treatments. However, many of our competitors have significantly greater financial resources and expertise in research and development, manufacturing, preclinical testing, conducting clinical trials, obtaining regulatory approvals, and marketing approved products than we do. Our competition can be grouped into three broad categories:

- Commercialized products and product candidates, as well as development programs that treat the same diseases for which we are also developing treatments. These companies include Oxthera AB, Allena Pharmaceuticals, Inc., and Arbutus Biopharma;
- Other companies working to develop RNAi therapeutic products. These companies include Alnylam Pharmaceuticals, Inc., Arrowhead Pharmaceuticals, Inc., Silence Therapeutics Plc, Quark Pharmaceuticals, Inc., Avidity Biosciences, Inc.; and
- Companies developing technology known as antisense, which, similar to the RNAi therapy we use, attempts to silence specific genes. These companies include Ionis Pharmaceuticals, Inc. and Wave Life Sciences Ltd.

Our success will be based, in part, upon our ability to identify, develop, and manage a portfolio of drugs that offer competitive advantages such as improved safety, more convenient dosing, and greater efficacy than competing products for the treatment of our targeted patients. Our commercial opportunity could be reduced or eliminated if our competitors develop and commercialize products that are superior to the products we may develop.

Summarized below is information on perceived competition for our most advanced product candidates.

Primary Hyperoxaluria

Currently, there are no approved drugs to treat primary hyperoxaluria. We believe that the following product candidates in clinical development, if approved, could compete with nedosiran:

Company	Drug	Drug Description	Phase
Alnylam Pharmaceuticals, Inc.	Lumasiran	RNAi therapeutic targeting glycolate oxidase specifically for the treatment of PH1	Rolling NDA submission
Oxthera AB	Oxabact	Bacteria intended to interact with the intestinal epithelial cells and promote secretion of oxalate from the body	Phase 3
Allena Pharmaceuticals, Inc.	Reloxaliase (formerly ALLN-177)	RNAi enzyme to reduce oxalate levels	Phase 2

There are also other companies that have preclinical development programs for the potential treatment of PH.

Hepatitis B Virus

Many companies across the biotechnology and pharmaceutical industries are seeking improved treatments for chronic HBV infection. It is generally accepted that improved treatments will consist of combinations of therapeutic agents, acting via different mechanisms of action. We consider our competitors to be those developing potential treatments for chronic HBV that act via a similar mechanism of action as our RG6346 product candidate; specifically, potential treatments that block or lead to the destruction of the mRNA and pgRNA of HBV. It may be possible for others to develop an improved treatment for chronic HBV that does not include this mechanism of action.

We believe that the following product candidates in clinical development, if approved, could compete with RG6346:

Company	Drug	Drug Description	Phase
Alnylam Pharmaceuticals, Inc. *Collaborative Partner: Vir Biotechnology*	ALN-HBV02 VIR-2218	RNAi-GalNAc conjugate	Phase 1/2
Arbutus Biopharma	AB-729	RNAi-GalNAc conjugate	Phase 1a/1b
Arrowhead Pharmaceuticals, Inc. *Collaborative Partner: Janssen*	JNJ-3989	RNAi-GalNAc conjugate	Phase 2
Ionis Pharmaceuticals, Inc. *Collaborative Partner: GlaxoSmithKline*	IONIS-HBV$_{RX}$	RNA-targeted antisense oligonucleotide	Phase 2
Ionis Pharmaceuticals, Inc. *Collaborative Partner: GlaxoSmithKline*	IONIS-HBV-L$_{RX}$	RNA-targeted antisense oligonucleotide-GalNAc conjugate	Phase 2

There are also other companies that have preclinical development programs for the potential treatment of HBV.

Alpha-1 Antitrypsin Deficiency-Associated Liver Disease

Currently, there are no approved drugs to treat alpha-1 antitrypsin deficiency-associated liver disease. We believe that the following product candidates in clinical development, if approved, could compete with DCR-A1AT:

Company	Drug	Drug Description	Phase
Arrowhead Pharmaceuticals, Inc.	ARO-AAT	RNAi-GalNAc conjugate	Phase 2/3
Alnylam Pharmaceuticals, Inc.	ALN-AAT02	RNAi-GalNAc conjugate	Phase 1/2
Vertex Pharmaceuticals, Inc.	VX-814	Oral small-molecule corrector of misfolded AAT protein	Phase 1
Vertex Pharmaceuticals, Inc.	VX-864	Oral small-molecule corrector of misfolded AAT protein	Phase 1

If our lead product candidates are approved for the indications for which we undertake clinical trials, they may compete with therapies that are either in development or currently marketed by our competitors. However, notwithstanding the availability of existing drugs or drug candidates, we believe sufficient unmet medical need exists to warrant the continuing advancement of our investigational RNAi therapeutic programs.

Sales and Marketing

Our current focus is on the development of our existing portfolio, the initiation and completion of clinical trials, and, where appropriate, the registration of our product candidates. We currently do not have marketing, sales, or distribution capabilities, although we are actively developing such capabilities. If we receive marketing and commercialization approval for any of our product candidates, we intend to market the product either directly or through strategic alliances and distribution agreements with third parties. The ultimate implementation of our strategy for realizing the financial value of our product candidates is dependent on the results of clinical trials for our product candidates, the availability of funds, our ability to obtain adequate coverage of and reimbursement for our products, compliance with laws governing our sales and marketing activities, and the ability to negotiate acceptable commercial terms with third parties.

Manufacturing and Supply

We do not currently own or operate any manufacturing facilities for the production of preclinical, clinical, or commercial quantities of any of our product candidates. For each product candidate, we currently contract with third-party manufacturers and suppliers for certain drug materials, and we expect to continue to do so to meet the preclinical and clinical requirements of our product candidates.

In November 2019, we entered into an initial five-year agreement with a supplier for the development, manufacture, and supply of clinical and commercial product. In January 2020, we executed an amendment to this agreement which allows for advance preferential scheduling to the manufacturing line.

We typically order raw materials and services on a purchase order basis. We have not entered into long-term purchase commitments; however, from time to time, we make binding demand-based forecasts nine to 18 months ahead of planned supply requirements.

Manufacturing is subject to extensive regulations that impose various procedural and documentation requirements, which govern record-keeping, manufacturing processes and controls, personnel, quality control, and quality assurance, among others. Our contract manufacturing organizations manufacture our product candidates under current Good Manufacturing Practice (“cGMP”) conditions. cGMP is a regulatory standard for the production of pharmaceuticals that will be used in humans.

Government Regulation and Product Approval

Governmental authorities in the U.S., at the federal, state and local level, and other countries extensively regulate, among other things, the research, development, testing, manufacture, quality control, approval, labeling, packaging, promotion, storage, record-keeping, advertising, distribution, sampling, pricing, sales and marketing, safety, post-approval monitoring and reporting, and export and import of products such as those we are developing. Our product candidates must be approved by the FDA through the NDA process before they may be legally marketed in the U.S. and will be subject to similar requirements in other countries prior to marketing in those countries. The process of obtaining regulatory approvals and the subsequent compliance with applicable federal, state, local and foreign statutes and regulations require the expenditure of substantial time and financial resources and the extensive laws and regulations that apply to drug products and product candidates in the U.S. are subject to change.

U.S. government regulation

NDA approval processes

In the U.S., the FDA regulates drugs under the Federal Food, Drug, and Cosmetic Act (the “FDCA”) and implementing regulations. Failure to comply with the applicable U.S. requirements at any time during the product development or approval process, or after approval, may result in a delay of approval or subject an applicant to administrative or judicial sanctions, any of which could have a material adverse effect on us. These sanctions could include:

- refusal to approve pending applications;
- withdrawal of an approval;
- imposition of a clinical hold;
- issuance of warning or untitled letters;
- product recalls;

- product seizures;
- refusals of government contracts;
- total or partial suspension of production or distribution; or
- injunctions, fines, restitution, disgorgement, civil penalties or criminal prosecution.

The process required by the FDA before a drug may be marketed in the U.S. generally includes the following:

- completion of non-clinical laboratory tests, animal studies, and formulation studies conducted according to Good Laboratory Practices ("GLPs") or other applicable laws and regulations;
- submission to the FDA of an IND, which must become effective before human clinical trials may begin;
- approval by an institutional review board ("IRB") at each clinical site before each trial may be initiated;
- performance and inspection of adequate and well-controlled human clinical trials and clinical data according to FDA regulations and Good Clinical Practices ("GCP") to establish the safety and efficacy of the product candidate for its intended use;
- submission of an NDA to the FDA and the FDA's acceptance of the NDA for filing;
- satisfactory completion of an FDA inspection of the manufacturing facility or facilities at which the product candidate is produced to assess compliance with cGMP to assure that the facilities, methods, and controls are adequate to preserve the product candidate's identity, strength, quality, and purity;
- satisfactory completion of an FDA inspection of the major investigational sites to ensure data integrity and assess compliance with GCP requirements; and
- FDA review and approval of the NDA.

Once a pharmaceutical candidate is identified for development, it enters the preclinical or non-clinical testing stage. Non-clinical tests include laboratory evaluations of product chemistry, stability, toxicity, and formulation, as well as animal studies. An IND sponsor must submit the results of the non-clinical tests, together with manufacturing information and analytical data, to the FDA as part of the IND. Some non-clinical testing may continue even after the IND is submitted. In addition to including the results of the non-clinical studies, manufacturing, and quality information, the IND will also include a protocol detailing, among other things, the objectives of the clinical trial, the parameters to be used in monitoring safety and the effectiveness criteria to be evaluated if the first phase lends itself to an efficacy determination. The IND automatically becomes effective 30 days after receipt by the FDA, unless the FDA, within the 30-day time period, places the IND on clinical hold. In such a case, the IND sponsor and the FDA must resolve any outstanding concerns before clinical trials can begin. A clinical hold may occur at any time during the life of an IND and may affect one or more specific studies or all studies conducted under the IND.

All clinical trials must be conducted under the supervision of one or more qualified investigators in accordance with FDA regulations and GCP. They must be conducted under protocols detailing the objectives of the trial, dosing procedures, research subject selection and exclusion criteria and the safety and effectiveness criteria to be evaluated. Each protocol and protocol amendments must be submitted to the FDA as part of the IND, and progress reports detailing the status of the clinical trials must be submitted to the FDA annually. Sponsors also must timely report to the FDA serious and unexpected adverse reactions, any clinically important increase in the rate of a serious suspected adverse reaction over that listed in the protocol or investigation brochure or any findings from other studies or animal or in vitro testing that suggest a significant risk in humans exposed to the drug. All research subjects or their legally authorized representatives must provide their informed consent in writing prior to their participation in a clinical trial. An IRB at each institution participating in the clinical trial must review and approve the protocol and the informed consent form before a clinical trial commences at that institution, monitor the study until completed and otherwise comply with IRB regulations. Information about most clinical trials must be submitted within specific timeframes to the National Institutes of Health ("NIH") to be publicly posted on the ClinicalTrials.gov website.

Human clinical trials are typically conducted in three sequential phases that may overlap or be combined.

- **Phase 1** – The product candidate is initially introduced into healthy human subjects and tested for safety, dosage tolerance, absorption, metabolism, distribution, and elimination. In the case of some product candidates for severe or life-threatening diseases, such as cancer, especially when the product candidate may be inherently too toxic to ethically administer to healthy volunteers, the initial human testing is often conducted in patients.
- **Phase 2** – Clinical trials are performed on a limited patient population intended to identify possible adverse effects and safety risks, to preliminarily evaluate the efficacy of the product for specific targeted diseases and to determine dosage tolerance and optimal dosage.

- **Phase 3** – Clinical trials are undertaken to further evaluate dosage, clinical efficacy, and safety in an expanded patient population at geographically dispersed clinical study sites. These studies are intended to establish the overall risk-benefit ratio of the product and provide an adequate basis for product labeling.

Human clinical trials are inherently uncertain, and Phase 1, Phase 2, and Phase 3 testing may not be successfully completed. The FDA, the sponsor, or a data safety monitoring board, may suspend a clinical trial at any time for a variety of reasons, including a finding that the research subjects or patients are being exposed to an unacceptable health risk. Similarly, an IRB can suspend or terminate approval of a clinical trial at its institution if the clinical trial is not being conducted in accordance with the IRB's requirements or if the product candidate has been associated with unexpected serious harm to patients.

During the development of a new product candidate, sponsors are given opportunities to meet with the FDA at certain points prior to the submission of an IND, at the end of Phase 2, and before an NDA is submitted. Meetings at other times may be requested. These meetings can provide an opportunity for the sponsor to share information about the data gathered to date and for the FDA to provide advice on the next phase of development. Sponsors typically use the meeting at the end of Phase 2 to discuss their Phase 2 clinical results and present their plans for the pivotal Phase 3 clinical trial that they believe will support the approval of an NDA. If a Phase 2 clinical trial is the subject of discussion at the end of Phase 2 meeting with the FDA, a sponsor may be able to request a Special Protocol Assessment, the purpose of which is to reach agreement with the FDA on the Phase 3 clinical trial protocol design and analysis that will form the primary basis of an efficacy claim. In the case of Breakthrough Therapy Designation, communication with the FDA may occur more frequently than as outlined above.

Concurrent with clinical trials, sponsors usually complete additional animal safety studies and also develop additional information about the chemistry and physical characteristics of the product candidate and finalize a process for manufacturing commercial quantities of the product candidate in accordance with cGMP requirements. The manufacturing process must be capable of consistently producing quality batches of the product candidate and the manufacturer must develop methods for testing the safety, identity, strength, purity, and quality of the product candidate. Additionally, appropriate packaging must be selected and tested and stability studies must be conducted to demonstrate that the product candidate does not undergo unacceptable deterioration over its proposed shelf-life. Before approving an NDA, the FDA will inspect the facility or facilities where the product is manufactured and tested and will not approve the product unless cGMP compliance is satisfactory. The FDA will also typically inspect one or more clinical sites to assure compliance with FDA regulations and GCP.

The results of product development, non-clinical studies and clinical trials, along with descriptions of the manufacturing process, analytical tests and other control mechanisms, proposed labeling and other relevant information are submitted to the FDA as part of an NDA requesting approval to market the product. The submission of an NDA is subject to the payment of user fees, but a waiver of such fees may be obtained under specified circumstances. The FDA reviews all NDAs submitted to ensure that they are sufficiently complete for substantive review before it accepts them for filing. It may request additional information rather than accept an NDA for filing. In this event, the NDA must be resubmitted with the additional information. The resubmitted application also is subject to review before the FDA accepts it for filing.

Once the submission is accepted for filing, the FDA begins an in-depth review. The FDA reviews an NDA to determine, among other things, whether a product is safe and effective for its intended use and whether its manufacturing is cGMP-compliant. The FDA typically requires that an NDA include data from two adequate and well-controlled clinical trials, but approval may be based upon a single adequate and well-controlled clinical trial in certain circumstances. The FDA may refuse to approve an NDA if the applicable regulatory criteria are not satisfied or may require additional clinical or other data. Even if such data are submitted, the FDA may ultimately decide that the NDA does not satisfy the criteria for approval. The FDA may refer the NDA to an advisory committee for review and recommendation as to whether the application should be approved and under what conditions. The FDA is not bound by the recommendation of an advisory committee, but it generally follows such recommendations.

If a product receives regulatory approval, the approval may be significantly limited to specific diseases and dosages or the indications for use may otherwise be limited, which could restrict the commercial value of the product. Further, the FDA may require that certain contraindications, warnings, or precautions be included in the product labeling. In addition, the FDA may condition approval on the completion of post approval studies. Such studies may involve clinical trials designed to further assess a product's safety and effectiveness and may require testing and surveillance programs to monitor the safety of approved products that have been commercialized. If the FDA determines that it is necessary to ensure the safe use of the drug, the FDA may also condition approval on the implementation of a risk evaluation and mitigation strategy ("REMS"). The REMS could include medication guides, physician communication plans, or elements to assure safe use, such as restricted distribution methods, patient registries, or other risk minimization tools.

Expedited review and approval

The FDA has various programs, including Fast Track, priority review, breakthrough, and accelerated approval, which are intended to expedite or simplify the process for reviewing product candidates. Generally, product candidates that are eligible for these programs are those for serious or life-threatening conditions, those with the potential to address unmet medical needs and those that offer meaningful benefits over existing treatments. A sponsor can request application of these programs either alone or in combination with each other, depending on the circumstances. Even if a product candidate qualifies for one or more of these programs, the FDA may later decide that the product candidate no longer meets the conditions for qualification or that the time period for FDA review or approval will be shortened. None of the expedited approval programs change the NDA approval standard applied to a product.

New drugs are eligible for Fast Track status if they are intended to treat a serious or life-threatening disease or condition and demonstrate the potential to address unmet medical needs for the disease or condition. Fast Track status entitles such a drug to expedited review and frequent contact with the FDA review division. Unlike other expedited review programs, Fast Track designation allows the FDA to accept for review individual sections of the NDA on a rolling basis. The FDA may also grant a priority review designation to drugs that offer major advances in treatment or provide a treatment where no adequate therapy exists. A priority review means that the goal for the FDA to review an application is six months from filing of an NDA, rather than the standard review of ten months from filing under current Prescription Drug User Fee Act guidelines. Most products that are eligible for Fast Track designation are also likely to be considered appropriate to receive a priority review.

Drug products studied for their safety and effectiveness in treating serious or life-threatening diseases or conditions may receive accelerated approval upon a determination that the product has an effect on a surrogate endpoint that is reasonably likely to predict clinical benefit, or on a clinical endpoint that can be measured earlier than irreversible morbidity or mortality, that is reasonably likely to predict an effect on irreversible morbidity or mortality or other clinical benefit, taking into account the severity, rarity, or prevalence of the condition and the availability or lack of alternative treatments. As a condition of approval, the FDA typically requires that a sponsor of a product candidate receiving accelerated approval conduct post-approval clinical trials. As an additional condition of approval, the FDA currently requires pre-approval of all promotional materials, which could adversely impact the timing of the commercial launch of the product.

The FDA may expedite the approval of a designated breakthrough therapy, which is a drug that is intended to treat a serious or life-threatening disease or condition for which preliminary clinical evidence indicates that the drug may demonstrate substantial improvement over existing therapies on one or more clinically significant endpoints, such as substantial treatment effects observed early in clinical development. A sponsor may request that a drug be designated as a breakthrough therapy at any time during the clinical development of the product. If the FDA designates a drug as a breakthrough therapy, the FDA must take the appropriate steps to expedite the development and review of the application, which may include holding meetings with the sponsor and the review team throughout the development of the drug; providing timely advice to the sponsor regarding the development of the drug to ensure that the development program is as efficient as practicable; involving senior managers and experienced review staff, as appropriate, in a collaborative, cross-disciplinary review; and taking steps to ensure that the design of the clinical trials is as efficient as practicable.

In December 2016, the 21st Century Cures Act (“Cures Act”), was signed into law. The Cures Act included numerous provisions that may be relevant to our product candidates, including provisions designed to speed development of innovative and breakthrough therapies. The Cures Act amends the FDCA and the Public Health Service Act, to reauthorize and expand funding for the NIH and to authorize the FDA to increase spending on innovation projects. Central to the Cures Act are provisions that enhance and accelerate the FDA’s processes for reviewing and approving new drugs and supplements to approved NDAs. The Cures Act also includes a provision that requires certain manufacturers or distributors of an investigational drug to make their policies on the availability of certain expanded access programs publicly available. Because the Cures Act was enacted relatively recently and the FDA may take several years to develop these policies, it is difficult to know the full extent of how the Cures Act will affect our business.

Patent term restoration and marketing exclusivity

Depending upon the timing, duration and specifics of FDA approval of the use of our product candidates, some of our U.S. patents may be eligible for limited patent term extension under the Drug Price Competition and Patent Term Restoration Act of 1984, referred to as the Hatch-Waxman Act. The Hatch-Waxman Act permits a patent restoration term of up to five years as compensation for patent term lost during product development and the FDA regulatory review process. However, patent term restoration cannot extend the remaining term of a patent beyond a total of 14 years from the product candidate’s approval date. The patent term restoration period is generally one half of the time between the effective date of an IND and the submission date of an NDA, plus the time between the submission date of an NDA and the approval of that application. Only one patent applicable to an approved product candidate is eligible for the extension and the application for extension must be made prior to expiration of the patent. The U.S. Patent and Trademark Office, in consultation with the FDA, reviews and approves the application for any patent term extension or restoration. In the future, we intend to apply for restorations of patent term for some of our currently owned or licensed patents to add

patent life beyond their current expiration date, depending on the expected length of clinical trials and other factors involved in the submission of the relevant NDA.

Market exclusivity provisions under the FDCA also can delay the submission or the approval of certain applications. The FDCA provides a five-year period of non-patent marketing exclusivity within the U.S. to the first applicant to gain approval of an NDA for a new chemical entity. A product candidate is a new chemical entity if the FDA has not previously approved any other new product candidate containing the same active moiety, which is the molecule or ion responsible for the action of the product candidate substance. During the exclusivity period, the FDA may not accept for review an abbreviated new drug application ("ANDA") or a 505(b)(2) NDA (i.e., an NDA that contains full safety and effectiveness reports but allows at least some of the information required for NDA approval to come from studies not conducted by or for the applicant) submitted by another company for another version of such product candidate where the applicant does not own or have a legal right of reference to all the data required for approval. However, an application may be submitted after four years if it contains a certification of patent invalidity or non-infringement. The FDCA also provides three years of marketing exclusivity for an NDA, 505(b)(2) NDA or supplement to an approved NDA if new clinical investigations, other than bioavailability studies, that were conducted or sponsored by the applicant are deemed by the FDA to be essential to the approval of the application, for example, for new indications, dosages or strengths of an existing product candidate. This three-year exclusivity covers only the conditions associated with the new clinical investigations and does not prohibit the FDA from approving ANDAs for product candidates containing the original active agent. Five-year and three-year exclusivity will not delay the submission or approval of a full NDA. However, an applicant submitting a full NDA would be required to conduct or obtain a right of reference to all of the preclinical studies and adequate and well-controlled clinical trials necessary to demonstrate safety and effectiveness.

Orphan drug designation

Under the Orphan Drug Act, the FDA may grant orphan drug designation to product candidates intended to treat a rare disease or condition, which is generally a disease or condition that affects fewer than 200,000 individuals in the U.S. or more than 200,000 individuals in the U.S. and for which there is no reasonable expectation that the cost of developing and making available in the U.S. a product candidate for this type of disease or condition will be recovered from sales in the U.S. for that product candidate. Orphan drug designation must be requested before submitting an NDA. After the FDA grants orphan drug designation, the identity of the therapeutic agent and its potential orphan use are disclosed publicly by the FDA. Orphan drug designation does not convey any advantage in or shorten the duration of the regulatory review and approval process.

If a product candidate that has orphan drug designation subsequently receives the first FDA approval for the disease for which it has such designation, the product candidate is entitled to orphan product exclusivity, which means that the FDA may not approve any other applications including a full NDA to market the same product candidate for the same indication, except in very limited circumstances, for seven years. Orphan drug exclusivity, however, could also block the approval of one of our product candidates for seven years if a competitor obtains approval of the same product candidate as defined by the FDA prior to us.

On August 8, 2017, the FDA Reauthorization Act of 2017 ("FDARA") was enacted. FDARA, among other things, codified the FDA's pre-existing regulatory interpretation, to require that a drug sponsor demonstrate the clinical superiority of an orphan drug that is otherwise the same as a previously approved drug for the same rare disease in order to receive orphan drug exclusivity. The new legislation reverses prior precedent holding that the Orphan Drug Act unambiguously requires that the FDA recognize the orphan exclusivity period regardless of a showing of clinical superiority. The FDA may further reevaluate the Orphan Drug Act, including the FDARA amendment, its regulations and policies. We do not know if, when, or how the FDA may change the orphan drug regulations and policies in the future, and it is uncertain how any changes might affect our business. Depending on what changes the FDA may make to its orphan drug regulations and policies, our business could be adversely impacted.

Pediatric exclusivity, pediatric use and rare pediatric disease priority review vouchers

Under the Best Pharmaceuticals for Children Act, certain product candidates may obtain an additional six months of exclusivity if the sponsor submits information requested in writing by the FDA (a "Written Request") relating to the use of the active moiety of the product candidate in children. The FDA may not issue a Written Request for studies on unapproved or approved indications or where it determines that information relating to the use of a product candidate in a pediatric population, or part of the pediatric population, may not produce health benefits in that population.

FDARA amended the FDCA to provide that a drug, for which an application has been submitted or approved pursuant to section 505(b)(2) or 505(j) of the FDCA, will not be considered ineligible for approval or misbranded because the labeling of such drug omits a pediatric indication or other pediatric labeling information when the omitted pediatric information is protected by patent or marketing exclusivity. FDARA further permits FDA to require specific labeling for such products related to the omitted pediatric indication and information to, among other things, make clear that the omission of the information is related to the exclusivity. We do not know if or how such changes to the pediatric exclusivity provisions might affect our business.

In addition, the Pediatric Research Equity Act ("PREA") requires a sponsor to conduct pediatric studies for most product candidates and biologics, for a new active ingredient, new indication, new dosage form, new dosing regimen or new route of administration. Under PREA, original NDAs, biologics license applications and supplements thereto must contain a pediatric assessment unless the sponsor has received a deferral or waiver. The required assessment must assess the safety and effectiveness of the product candidate for the claimed indications in all relevant pediatric subpopulations and support dosing and administration for each pediatric subpopulation for which the product candidate is safe and effective. The sponsor or the FDA may request a deferral of pediatric studies for some or all of the pediatric subpopulations. A deferral may be granted for several reasons, including a finding that the product candidate or biologic is ready for approval for use in adults before pediatric studies are complete or that additional safety or effectiveness data needs to be collected before the pediatric studies begin. After April 2013, the FDA must send a noncompliance letter to any sponsor that fails to submit the required assessment, keep a deferral current or fails to submit a request for approval of a pediatric formulation. PREA does not apply to any drug for an indication for which orphan designation has been granted. However, if only one indication for a product has orphan designation, a pediatric assessment may still be required for any applications to market that same product for the non-orphan indication(s).

Section 529 of the FDCA is intended to encourage development of new drug and biological products for prevention and treatment of certain rare pediatric diseases. Although there are existing incentive programs to encourage the development and study of drugs for rare diseases, pediatric populations, and unmet medical needs, section 529 provides an additional incentive for rare pediatric diseases, which may be used alone or in combination with other incentive programs. "Rare pediatric disease" is defined as a disease that:

- is "a serious or life-threatening disease in which the serious or life-threatening manifestations primarily affect individuals aged from birth to 18 years, including age groups often called neonates, infants, children, and adolescents"; and
- is "a rare disease or condition" as defined in the FDCA, which includes diseases and conditions that affect fewer than 200,000 persons in the U.S. and diseases and conditions that affect a larger number of persons and for which there is no reasonable expectation that the costs of developing and making available the drug in the U.S. can be recovered from sales of the drug in the U.S.

Under section 529, the sponsor of a human drug application for a rare pediatric disease drug product may be eligible for a voucher that can be used (or sold) to obtain a priority review for a subsequent human drug application submitted under section 505(b)(1) of the FDCA or section 351 of the Public Health Service Act after the date of approval of the rare pediatric disease drug product. The rare pediatric disease priority review vouchers program was re-authorized by Congress in the Cures Act, extending the program through 2020. The FDA has issued draft Guidance for Industry for Rare Pediatric Disease Priority Review Vouchers.

Post-approval requirements

Once an approval is granted, the FDA may withdraw the approval if compliance with regulatory requirements is not maintained or if problems occur after the product candidate reaches the market. Requirements for additional Phase 4 trials (post-approval marketing studies) to confirm safety and efficacy may be imposed as a condition of approval. Later discovery of previously unknown problems with a product candidate may result in REMS or even complete withdrawal of the product candidate from the market. After approval, some types of changes to the approved product candidate, such as adding new indications, manufacturing changes and additional labeling changes, are subject to further FDA review and approval. In addition, the FDA may require testing and surveillance programs to monitor the effect of approved product candidates that have been commercialized, and the FDA has the power to prevent or limit further marketing of a product candidate based on the results of these post-marketing programs.

Any product candidates manufactured or distributed by us pursuant to FDA approvals are subject to continuing regulation by the FDA, including, among other things:

- record-keeping requirements;
- reporting of adverse experiences with the product candidate;
- submission of periodic reports;
- providing the FDA with updated safety and efficacy information;
- drug sampling, stability and distribution requirements;
- notifying the FDA and gaining its approval of specified manufacturing or labeling changes; and
- complying with statutory and regulatory requirements for promotion and advertising.

Drug manufacturers and other entities involved in the manufacture and distribution of approved product candidates are required to register their establishments and provide product listing information to the FDA and certain state agencies and are subject to periodic unannounced inspections by the FDA and some state agencies for compliance with cGMP and other laws.

Regulation outside of the U.S.

In addition to regulations in the U.S., we will be subject to regulations of other jurisdictions governing any clinical trials and commercial sales and distribution of our product candidates. Whether or not we obtain FDA approval for a product, we must obtain approval by the comparable regulatory authorities of countries outside of the U.S. before we can commence clinical trials in such countries, and approval of the regulators of such countries or supranational areas, such as the European Union ("EU"), before we may market products in those countries or areas. The approval process and requirements governing the conduct of clinical trials, product licensing, pricing and reimbursement vary greatly from place to place, and the time may be longer or shorter than that required for FDA approval.

Under EU regulatory systems, a company may submit marketing authorization applications either under a centralized or decentralized procedure. The centralized procedure, which is compulsory for certain medicines, including those produced by biotechnology or those intended to treat HIV, AIDS, cancer, neurodegenerative disorders, autoimmune and other immune dysfunctions, viral diseases or diabetes and is optional for those medicines which are a significant therapeutic, scientific or technical innovation or whose authorization would be in the interest of public health, provides for the grant of a single marketing authorization that is valid for all EU member states. Through the decentralized procedure, a medicinal product that has not yet been authorized in the EU can be simultaneously authorized in several EU member states. The mutual recognition procedure provides for mutual recognition of national approval decisions. Under this procedure, the holder of a national marketing authorization may submit an application to the remaining member states. Within 90 days of receiving the applications and assessment reports, each member state must decide whether to recognize the approval. If a member state does not recognize the marketing authorization, the disputed points are eventually referred to the European Commission, whose decision is binding on all member states.

As in the U.S., we may apply for designation of a product candidate as an orphan drug for the treatment of a specific indication in the EU before the application for marketing authorization is made. Sponsors of orphan drugs in the EU can enjoy economic and marketing benefits, including up to 10 years of market exclusivity for the approved indication. During such period, marketing authorization applications for "similar" medicinal products will not be accepted, unless another applicant can show that its product is safer, more effective or otherwise clinically superior to the orphan-designated product. In the EU, a "similar medicinal product" is a medicinal product containing a similar active substance or substances as contained in a currently authorized orphan medicinal product, and which is intended for the same therapeutic indication.

Coverage and Reimbursement

In the U.S. and markets in other countries, patients who are prescribed treatments for their conditions and providers performing the prescribed services generally rely only on third-party payors to reimburse all or part of the associated healthcare costs. Thus, sales of our products will depend, in part, on the extent to which the costs of our products will be covered and paid for by third-party payors, such as government health programs, commercial insurance and managed healthcare organizations. In the United States, no uniform policy of coverage and reimbursement for products exists among third-party payors. Therefore, coverage and reimbursement for products can differ significantly from payor to payor. The process for determining whether a third-party payor will provide coverage for a product may be separate from the process for setting the price or reimbursement rate that the payor will pay for the product once coverage is approved. Third-party payors may limit coverage to specific products on an approved list or formulary, which might not include all of the FDA-approved products for a particular indication. Also, third-party payors may refuse to include a particular branded drug on their formularies or otherwise restrict patient access to a branded drug when a less costly generic equivalent or another alternative is available. Third-party payors are increasingly challenging the prices charged for medical products and services, examining the medical necessity, and reviewing the cost-effectiveness of medical products and services and imposing controls to manage costs.

In order to secure coverage and reimbursement for any product that might be approved for sale, a company may need to conduct expensive pharmacoeconomic studies in order to demonstrate the medical necessity and cost-effectiveness of the product, in addition to the costs required to obtain FDA or other comparable regulatory approvals. Additionally, companies may also need to provide discounts to purchases, private health plans, or government healthcare programs. Nonetheless, products may not be considered medically necessary or cost effective. A decision by a third-party payor not to cover a product could reduce physician utilization once the product is approved and have a material adverse effect on sales, results of operations, and financial condition. Additionally, a third-party payor's decision to provide coverage for a product does not imply that an adequate reimbursement rate will be approved. Further, one payor's determination to provide coverage for a product does not assure that other payors will also provide coverage and reimbursement for the product, and the level of coverage and reimbursement can differ significantly from payor to payor.

Additionally, the containment of healthcare costs has become a priority of federal and state governments, and the prices of drugs have been a focus in this effort. The U.S. government, state legislatures and foreign governments have shown significant interest in implementing cost-containment programs, including price controls, restrictions on reimbursement and requirements for substitution of generic products. For example, the current U.S. administration has indicated support for possible new measures to regulate drug pricing. Adoption of price controls and cost-containment measures, and adoption of more restrictive policies in jurisdictions with existing controls and measures, could significantly limit our net revenue and financial results. If these third-party payors do not consider our products to be cost-effective compared to other therapies, they may not cover our products after approved as a benefit under their plans or, if they do, the level of payment may not be sufficient to allow us to sell our products on a profitable basis.

The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 ("MMA") imposed new requirements for the distribution and pricing of prescription drugs for Medicare beneficiaries. Under Part D, Medicare beneficiaries may enroll in prescription drug plans offered by private entities which will provide coverage of outpatient prescription drugs. Part D plans include both stand-alone prescription drug benefit plans and prescription drug coverage as a supplement to Medicare Advantage plans. Unlike Medicare Part A and B, Part D coverage is not standardized. Part D prescription drug plan sponsors are not required to pay for all covered Part D drugs, and each drug plan can develop its own drug formulary that identifies which drugs it will cover and at what tier or level. However, Part D prescription drug formularies must include drugs within each therapeutic category and class of covered Part D drugs, though not necessarily all the drugs in each category or class. Any formulary used by a Part D prescription drug plan must be developed and reviewed by a pharmacy and therapeutic committee. Government payment for some of the costs of prescription drugs may increase demand for our products for which we receive marketing approval. However, any negotiated prices for our products covered by a Part D prescription drug plan will likely be lower than the prices we might otherwise obtain. Moreover, while the MMA applies only to drug benefits for Medicare beneficiaries, private payors often follow Medicare coverage policy and payment limitations in setting their own payment rates. Any reduction in payment that results from the MMA may result in a similar reduction in payments from non-governmental payors.

The Patient Protection and Affordable Care Act, as amended by the Health Care and Education Affordability Reconciliation Act of 2010, collectively referred to as the ACA, enacted in March 2010, has had a significant impact on the health care industry by, for example, expanding coverage for the uninsured and seeking to contain overall healthcare costs. Regarding pharmaceutical products, among other things, the ACA contains provisions of importance to our potential product candidates, including among other things, provisions that:

- created an annual, nondeductible fee on any entity that manufactures or imports specified branded prescription drugs and biologic products, apportioned among these entities according to their market share in certain government healthcare programs;
- expanded eligibility criteria for Medicaid programs by, among other things, allowing states to offer Medicaid coverage to certain individuals with income at or below 133% of the federal poverty level, thereby potentially increasing a manufacturer's Medicaid rebate liability;
- expanded manufacturers' rebate liability under the Medicaid Drug Rebate Program by increasing the minimum rebate for both branded and generic drugs and revising the definition of average manufacturer price ("AMP") for calculating and reporting Medicaid drug rebates on outpatient prescription drug prices;
- addressed a new methodology by which rebates owed by manufacturers under the Medicaid Drug Rebate Program are calculated for drugs that are inhaled, infused, instilled, implanted, or injected;
- expanded the types of entities eligible for the 340B drug discount program; and
- created a new Patient-Centered Outcomes Research Institute to oversee, identify priorities in, and conduct comparative clinical effectiveness research, along with funding for such research.

Recently, the current U.S. administration and U.S. Congress have expressed a desire to modify, repeal, or otherwise invalidate all, or certain provisions of, the ACA, which has contributed to the uncertainty of the ongoing implementation and impact of the ACA and also underscores the potential for additional health care reform going forward. For example, the Tax Cuts and Jobs Act of 2017 includes a provision effective January 1, 2019, repealing the tax-based shared responsibility payment imposed by the ACA on certain individuals who fail to maintain qualifying health coverage for all or part of a year that is commonly referred to as the "individual mandate." On December 14, 2018, a Texas U.S. District Court judge ruled that the ACA is unconstitutional in its entirety because the "individual mandate" was repealed by Congress as part of the Tax Cuts and Jobs Act of 2017. On December 18, 2019, the Fifth Circuit U.S. Court of Appeals held that the individual mandate is unconstitutional, and remanded the case to the lower court to reconsider its earlier invalidation of the full ACA. Congress may consider other legislation that would alter other aspects of the ACA.

There is still uncertainty with respect to the impact the current U.S. administration, the U.S. Congress, and the courts may have, if any, and any changes will likely take time to unfold. Such reforms could have an adverse effect on anticipated revenues from

product candidates that we may successfully develop and for which we may obtain regulatory approval and may affect our overall financial condition and ability to develop product candidates.

Further legislation or regulation could be passed that could harm our business, financial condition and results of operations. Other legislative changes have been proposed and adopted since the ACA was enacted. For example, in August 2011, President Obama signed into law the Budget Control Act of 2011, which, among other things, created the Joint Select Committee on Deficit Reduction to recommend to Congress proposals in spending reductions. The Joint Select Committee on Deficit Reduction did not achieve a targeted deficit reduction of at least $1.2 trillion for fiscal years 2012 through 2021, triggering the legislation's automatic reduction to several government programs. This includes aggregate reductions to Medicare payments to providers of up to 2% per fiscal year, which went into effect beginning on April 1, 2013 and will stay in effect through 2027 unless additional Congressional action is taken. In addition, on February 9, 2018, Congress passed the Bipartisan Budget Act that made several healthcare reforms. For example, the law changes the discounts manufacturers are required to apply to their drugs under the Coverage Gap Discount Program from 50% to 70% of the negotiated price starting in 2019. In addition, the law increases civil and criminal penalties for fraud and abuse laws, including, for example, increases in both criminal fines for violations of the Anti-Kickback Statute and corresponding prison sentences.

Also, there has been heightened governmental scrutiny recently over the manner in which drug manufacturers set prices for their marketed products, which have resulted in several Congressional inquiries and proposed bills designed to, among other things, bring more transparency to product pricing, review the relationship between pricing and manufacturer patient programs, and reform government program reimbursement methodologies for drug products. For example, on September 25, 2019, the Senate Finance Committee introduced the Prescription Drug Pricing Reduction Action of 2019, a bill intended to reduce Medicare and Medicaid prescription drug prices. The proposed legislation would restructure the Part D benefit, modify payment methodologies for certain drugs, and impose an inflation cap on drug price increases. An even more restrictive bill, the Lower Drugs Costs Now Act of 2019 has passed out of the House and was delivered to the Senate on December 16, 2019, and would require Department of Health and Human Services ("HHS") to directly negotiate drug prices with manufacturers. It is unclear whether either of these bills will make it through both chambers and be signed into law, and if either is enacted, what effect it would have on our business. Individual states in the United States have also become increasingly aggressive in passing legislation and implementing regulations designed to control pharmaceutical and biological product pricing, including price or patient reimbursement constraints, discounts, restrictions on certain product access and marketing cost disclosure and transparency measures. For example, in September 2017, the California State Assembly approved SB17 which requires pharmaceutical companies to notify health insurers and government health plans at least 60 days before certain scheduled increases in the prices of their products, and further requiring pharmaceutical companies to explain the reasons for such increases. Effective in 2016, Vermont passed a law requiring a certain manufacturer identified by the state to justify their price increases.

In addition, in some non-U.S. jurisdictions, the proposed pricing for a product candidate must be approved before it may be lawfully marketed. The requirements governing drug pricing vary widely from country to country. For example, the EU provides options for its member states to restrict the range of medicinal products for which their national health insurance systems provide reimbursement and to control the prices of medicinal products for human use. A member state may approve a specific price for the medicinal product or it may instead adopt a system of direct or indirect controls on the profitability of the company placing the medicinal product on the market. There can be no assurance that any country that has price controls and/or reimbursement limitations for pharmaceutical products will allow favorable reimbursement and pricing arrangements for any of our product candidates. Historically, product candidates launched in the EU do not follow price structures of the U.S. and generally tend to have price structures that are significantly lower.

Other Healthcare Fraud and Laws

In the U.S., our activities are potentially subject to regulation by various federal, state and local authorities in addition to the FDA, including but not limited to, the Centers for Medicare and Medicaid Services ("CMS"), other divisions of the HHS (such as the Office of Inspector General and the Health Resources and Service Administration), the U.S. Department of Justice (the "DOJ") and individual U.S. Attorney offices within the DOJ, and state and local governments. For example, sales, marketing and scientific/educational grant programs may have to comply with the anti-fraud and abuse provisions of the Social Security Act, the false claims laws, the privacy and security provisions of the Health Insurance Portability and Accountability Act ("HIPAA") and similar state laws, each as amended, as applicable.

The federal Anti-Kickback Statute prohibits, among other things, any person or entity, from knowingly and willfully offering, paying, soliciting or receiving any remuneration, directly or indirectly, overtly or covertly, in cash or in kind, to induce or in return for purchasing, leasing, ordering or arranging for the purchase, lease or order of any item or service reimbursable, in whole or in part, under Medicare, Medicaid or other federal healthcare programs. The term remuneration has been interpreted broadly to include anything of value. The Anti-Kickback Statute has been interpreted to apply to arrangements between therapeutic product manufacturers on one hand and prescribers, purchasers, and formulary managers on the other. There are a number of statutory

exceptions and regulatory safe harbors protecting some common activities from prosecution. The exceptions and safe harbors are drawn narrowly and practices that involve remuneration that may be alleged to be intended to induce prescribing, purchasing or recommending may be subject to scrutiny if they do not qualify for an exception or safe harbor. Failure to meet all of the requirements of a particular applicable statutory exception or regulatory safe harbor does not make the conduct per se illegal under the Anti-Kickback Statute. Instead, the legality of the arrangement will be evaluated on a case-by-case basis based on a cumulative review of all of its facts and circumstances. Additionally, the intent standard under the Anti-Kickback Statute was amended by the ACA to a stricter standard such that a person or entity no longer needs to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation. In addition, the ACA codified case law that a claim including items or services resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the federal False Claims Act (the "FCA") (discussed below).

The federal false claims and civil monetary penalty laws, including the FCA, which imposes significant penalties and can be enforced by private citizens through civil qui tam actions, prohibit any person or entity from, among other things, knowingly presenting, or causing to be presented, a false or fraudulent claim for payment to, or approval by, the federal healthcare programs, including Medicare and Medicaid, or knowingly making, using, or causing to be made or used a false record or statement material to a false or fraudulent claim to the federal government. A claim includes "any request or demand" for money or property presented to the U.S. government. Manufacturers can be held liable under the FCA even when they do not submit claims directly to government payors if they are deemed to "cause" the submission of false or fraudulent claims.

HIPAA created additional federal criminal statutes that prohibit, among other things, knowingly and willfully executing, or attempting to execute, a scheme to defraud or to obtain, by means of false or fraudulent pretenses, representations or promises, any money or property owned by, or under the control or custody of, any healthcare benefit program, including private third-party payors, willfully obstructing a criminal investigation of a healthcare offense, and knowingly and willfully falsifying, concealing or covering up by trick, scheme or device, a material fact or making any materially false, fictitious or fraudulent statement in connection with the delivery of or payment for healthcare benefits, items or services. Like the Anti-Kickback Statute, the ACA amended the intent standard for certain healthcare fraud statutes under HIPAA such that a person or entity no longer needs to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation.

Also, many states have similar, and typically more prohibitive, fraud and abuse statutes or regulations that apply to items and services reimbursed under Medicaid and other state programs, or, in several states, apply regardless of the payor. Additionally, to the extent that our product candidates may in the future be sold in a foreign country, we may be subject to similar foreign laws.

We may be subject to data privacy and security regulations by both the federal government and the states in which we conduct our business. HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act ("HITECH") and its implementing regulations, imposes requirements relating to the privacy, security and transmission of individually identifiable health information. Among other things, HITECH makes HIPAA's privacy and security standards directly applicable to business associates, independent contractors, or agents of covered entities that receive or obtain protected health information in connection with providing a service on behalf of a covered entity. HITECH also created four new tiers of civil monetary penalties, amended HIPAA to make civil and criminal penalties directly applicable to business associates, and gave state attorneys general new authority to file civil actions for damages or injunctions in federal courts to enforce HIPAA and seek attorneys' fees and costs associated with pursuing federal civil actions. In addition, many state laws govern the privacy and security of health information in specified circumstances, many of which differ from each other in significant ways, are often not preempted by HIPAA, and may have a more prohibitive effect than HIPAA, thus complicating compliance efforts. Additionally, more general personal privacy laws have also been enacted by various States and by other countries where we do business, such as member countries of the European Union, that require adoption of policies and procedures to protect, properly store, and to obtain permission to use in our business and clinical research.

For example, in California, the California Consumer Protection Act ("CCPA"), which went into effect on January 1, 2020, established a new privacy framework for covered businesses by creating an expanded definition of personal information, establishing new data privacy rights for consumers in the State of California, imposing special rules on the collection of consumer data from minors, and creating a new and potentially severe statutory damages framework for violations of the CCPA and for businesses that fail to implement reasonable security procedures and practices to prevent data breaches. While clinical trial data and information governed by HIPAA are currently exempt from the current version of the CCPA, other personal information may be applicable and possible changes to the CCPA may broaden its scope. The collection and use of personal health information in the European Union is governed by the provisions of the Data Protection Directive, and as of May 25, 2018, the General Data Protection Regulation ("GDPR"). This directive imposes several requirements relating to the consent of the individuals to whom the personal data relates, the information provided to the individuals, notification of data processing obligations to the competent national data protection authorities, and the security and confidentiality of the personal data. The GDPR also imposes strict rules on the transfer of personal data out of the EU to the United States. Failure to comply with the requirements of the Data Protection Directive (which governs the collection and use of personal health data in the EU), the GDPR, and the related national data protection laws of the EU member states may result in fines and other administrative penalties. The GDPR introduced new data protection requirements in the EU and substantial fines for

breaches of the data protection rules. This may be onerous and may adversely affect our business, financial condition, results of operations, and prospects.

Failure to comply could result in penalties and interruption of our business should a violation occur.

We expect our product candidates, once approved, may be eligible for coverage under Medicare, the federal health care program that provides health care benefits to the aged and disabled, and covers outpatient services and supplies, including certain pharmaceutical products, that are medically necessary to treat a beneficiary's health condition. In addition, our product candidates may be covered and reimbursed under other government programs, such as Medicaid and the 340B Drug Pricing Program. The Medicaid Drug Rebate Program requires pharmaceutical manufacturers to enter into and have in effect a national rebate agreement with the Secretary of the Department of Health and Human Services as a condition for states to receive federal matching funds for the manufacturer's outpatient drugs furnished to Medicaid patients. Under the 340B Drug Pricing Program, the manufacturer must extend discounts to entities that participate in the program. As part of the requirements to participate in certain government programs, many pharmaceutical manufacturers must calculate and report certain price reporting metrics to the government, such as average manufacturer price, or AMP, and best price. Penalties may apply in some cases when such metrics are not submitted accurately and timely.

Additionally, the federal Physician Payments Sunshine Act (the "Sunshine Act"), within the ACA, and its implementing regulations, require that certain manufacturers of drugs, devices, biological and medical supplies for which payment is available under Medicare, Medicaid or the Children's Health Insurance Program (with certain exceptions) report annually to CMS information related to certain payments or other transfers of value made or distributed to physicians and teaching hospitals, or to entities or individuals at the request of, or designated on behalf of, the physicians and teaching hospitals and to report annually certain ownership and investment interests held by physicians and their immediate family members. Failure to report accurately could result in penalties. In addition, many states also govern the reporting of payments or other transfers of value, many of which differ from each other in significant ways, are often not preempted, and may have a more prohibitive effect than the Sunshine Act, thus further complicating compliance efforts.

Environment

Our third-party manufacturers are subject to inspections by the FDA for compliance with cGMP and other U.S. regulatory requirements, including U.S. federal, state, and local regulations regarding environmental protection and hazardous and controlled substance controls, among others. Environmental laws and regulations are complex, change frequently, and have tended to become more stringent over time. We have incurred, and may continue to incur, significant expenditures to ensure we are in compliance with these laws and regulations. We would be subject to significant penalties for failure to comply with these laws and regulations.

Employees

As of December 31, 2019, we had 187 full-time employees, of whom 138 are engaged in research and development and 49 in administration. None of our employees are represented by a labor union or covered by a collective bargaining agreement. Geographically, 154 of our employees are located in Massachusetts, 25 in Colorado, and one each in Connecticut, Maryland, New Jersey, New York, North Carolina, and Wisconsin, United States. Two of our employees are located in Germany.

Corporate Information

We were incorporated in Delaware in 2006. We maintain our executive offices at 33 Hayden Avenue, Lexington, MA 02421, and our main telephone number is (617) 621-8097. Our website is located at www.dicerna.com, which contains information about us. The information in, or that can be accessed through, our website is not part of this Annual Report on Form 10-K. Our Annual Report on Form 10-K, Quarterly Reports on Form 10-Q, and Current Reports on Form 8-K, and amendments to those reports filed or furnished pursuant to Section 13(a) or 15(d) of the Exchange Act are available, free of charge, on or through our website as soon as reasonably practicable after such reports and amendments are electronically filed with or furnished to the SEC. The SEC maintains an Internet site that contains reports, proxy and information statements, and other information regarding our filings at www.sec.gov.

ITEM 1A. RISK FACTORS

We are providing the following cautionary discussion of risk factors, uncertainties, and assumptions that we believe are relevant to our business. These are factors that we believe, individually or in the aggregate, could cause our actual results to differ materially from expected and historical results and our forward-looking statements. We note these factors for investors as permitted by Section 21E of the Securities Exchange Act of 1934, as amended, and Section 27A of the Securities Act of 1933, as amended. You should understand that it is not possible to predict or identify all such factors. Consequently, you should not consider this section to be a complete discussion of all potential risks or uncertainties that may substantially impact our business. Moreover, we operate in a competitive and rapidly changing environment. New factors emerge from time to time, and it is not possible to predict the impact of all these factors on our business, financial condition, or results of operations.

Risks Related to Our Business

We will need to raise substantial additional funds to advance development of our product candidates and we cannot guarantee that we will have sufficient funds available in the future to develop and commercialize our current or future product candidates. Raising additional funds may cause dilution to our stockholders, restrict our operations, or require us to relinquish control over our technologies or product candidates.

We will need to raise substantial additional funds to expand our development, regulatory, manufacturing, marketing, sales, and general and administrative operations capabilities, whether internally or through other organizations. We have used substantial funds to develop our product candidates and delivery technologies and will require significant funds to conduct further research and development and preclinical testing and clinical trials of our product candidates, to seek regulatory approvals for our product candidates, and to manufacture and market products, if any are approved for commercial sale. As of December 31, 2019, we had $348.9 million in cash, cash equivalents, and held-to-maturity investments. Based on our current operating plan and liquidity, we believe that our available cash, cash equivalents, and held-to-maturity investments, together with the $200.0 million upfront payment received from F. Hoffmann-La Roche Ltd and Hoffmann-La Roche Inc. (together, “Roche”) and the $175.0 million upfront payment received from our recently announced agreement with Novo Nordisk A/S (“Novo”) in January 2020, will be sufficient to fund the execution of our current clinical and operating plan into 2023. However, to the extent our clinical and operating plan changes, we will need to raise substantial additional funds. Further, our future capital requirements and the period for which our existing resources are able to support our operations may vary significantly from what we expect. Our monthly spending levels vary based on new and ongoing development and corporate activities. Because the length of time and activities associated with successful development of our product candidates is highly uncertain, we are unable to estimate the actual funds we will require for development and any approved marketing and commercialization activities. To execute our business plan, we will need, among other things:

- to obtain the human and financial resources necessary to develop, test, obtain regulatory approval for, manufacture, and market our product candidates;
- to build and maintain a strong intellectual property portfolio and avoid infringing intellectual property of third parties;
- to establish and maintain successful licenses, collaborations, and alliances;
- to satisfy the requirements of clinical trial protocols, including patient enrollment;
- to establish and demonstrate the clinical efficacy and safety of our product candidates;
- to manage our spending as costs and expenses increase due to preclinical studies and clinical trials, regulatory approvals, manufacturing scale-up, and commercialization;
- to obtain additional capital to support and expand our operations;
- to satisfy the requirements for quality and safety in developing and commercializing our products; and
- to market our products to achieve acceptance and use by the medical community.

If we are unable to obtain funding on a timely basis or on acceptable terms, we may have to delay, reduce, or terminate our research and development programs and preclinical studies or clinical trials, if any, delay or cease our efforts to build our commercial capabilities, limit strategic opportunities, or undergo reductions in our workforce or other corporate restructuring activities. We also could be required to seek funds through arrangements with collaborators or others that may require us to relinquish development or commercialization rights to some of our technologies or product candidates that we would otherwise pursue on our own. We do not expect to realize revenue from product sales or royalties in the near-term future, if at all, and milestone payments, if any, are based on third-party determinations and/or events outside our control. Our revenue sources currently are, and will remain, limited unless and until our product candidates are clinically tested, approved for commercialization, and successfully marketed. To date, we have financed our operations primarily through the sale of securities, research collaborations and license agreements, debt financings, and

credit and loan facilities. We will be required to seek additional funding in the future and intend to do so through a combination of public or private equity offerings, debt financings, and research collaborations and license agreements. Our ability to raise additional funds will depend on financial, economic, and other factors, many of which are beyond our control. For example, a number of factors, including the timing and outcomes of our clinical activities, as well as conditions in the global financial markets, may present significant challenges to accessing the capital markets at a time when we would like or require, and at an increased cost of capital. Additional funds may not be available to us on acceptable terms or at all. If we raise additional funds by issuing equity securities, our stockholders will suffer dilution, and the terms of any financing may adversely affect the rights of our stockholders. In addition, as a condition to providing additional funds to us, future investors may demand, and may be granted, rights superior to those of existing stockholders. Debt financing, if available, may involve restrictive covenants limiting our flexibility in conducting future business activities, and, in the event of insolvency, debt holders would be repaid before holders of equity securities receive any distribution of corporate assets.

We have a history of operating losses; we expect to continue to incur significant losses for the foreseeable future and may never achieve or maintain profitability, which could result in a decline in the market value of our common stock.

We are a biopharmaceutical company with a limited operating history focused on the discovery and development of treatments based on the emerging therapeutic modality RNAi, a biological process in which RNA molecules inhibit gene expression. Since our inception in October 2006, we have devoted our resources to the development of RNAi molecules and delivery technologies. We have had significant operating losses since our inception. As of December 31, 2019, we had an accumulated deficit of $525.3 million. For the years ended December 31, 2019, 2018, and 2017, our net loss attributable to common stockholders was $120.5 million, $88.9 million, and $80.3 million, respectively. Substantially all of our operating losses have resulted from expenses incurred in connection with our research and development programs, from general and administrative costs associated with our operations, and, prior to 2019, litigation expenses associated with the Alnylam Pharmaceuticals, Inc. (“Alnylam”) litigation settled in April 2018. Our technologies and product candidates are in early stages of development, and we are subject to the risks of failure inherent in the development of product candidates based on novel technologies.

We have not generated, and do not expect to generate, any revenue from product sales for the near-term future, and we expect to continue to incur significant operating losses for the foreseeable future due to the cost of research and development, preclinical studies and clinical trials, and the regulatory approval process for product candidates. The amount of future losses is uncertain. Our ability to achieve profitability, if ever, will depend on, among other things, us or our existing collaborators, or any future collaborators, successfully developing product candidates, obtaining regulatory approvals to market and commercialize product candidates, manufacturing any approved products on commercially reasonable terms, establishing a sales and marketing organization or suitable third-party alternatives for any approved product, and raising sufficient funds to finance business activities. If we or our existing collaborators, or any future collaborators, are unable to develop and commercialize one or more of our product candidates or if sales revenue from any product candidate that receives approval is insufficient, we will not achieve profitability, which could have a material adverse effect on our business, financial condition, results of operations, and prospects.

Our quarterly operating results may fluctuate significantly or may fall below the expectations of investors or securities analysts, each of which may cause our stock price to fluctuate or decline.

We expect our operating results to be subject to quarterly fluctuations. Our net loss and other operating results will be affected by numerous factors, including:

- variations in the level of expense related to our product candidates or future development programs;
- delays in enrolling subjects in, initiating, conducting, or releasing results of clinical trials, or the addition or termination of clinical trials or funding support by us, our existing collaborators, or any future collaborator or licensor;
- the timing of the release of results from any clinical trials conducted by us or our collaborators or licensors;
- our execution of any collaboration, licensing, or similar arrangement, and the timing of payments we may make or receive under such existing or future arrangements or the termination or modification of any such existing or future arrangements;
- any intellectual property infringement or misappropriation lawsuit or opposition, interference, re-examination, post-grant review, *inter partes* review, nullification, derivation action, or cancellation proceeding in which we may become involved;
- additions and departures of key personnel;
- strategic decisions by us and our competitors, such as acquisitions, divestitures, spin-offs, joint ventures, strategic investments, or changes in business strategy;
- if any of our product candidates receive regulatory approval, market acceptance and demand for such product candidates;

- delays in engagement of our third-party manufacturers for our product candidates or their failure to execute on our manufacturing requirements or perform in accordance with current good manufacturing practices ("cGMP");
- timing of regulatory decisions and regulatory developments affecting our product candidates or those of our competitors;
- disputes concerning patents, proprietary rights, or license and collaboration agreements that negatively impact our receipt of milestone payments or royalties or require us to make significant payments arising from licenses, settlements, adverse judgments, or ongoing royalties;
- changes in general market and economic conditions; and
- changes in tax laws.

If our quarterly operating results fluctuate or fall below the expectations of investors or securities analysts, the price of our common stock could fluctuate or decline substantially. We believe that quarterly comparisons of our financial results are not necessarily meaningful and should not be relied upon as an indication of our future performance.

Our approach to the discovery and development of innovative therapeutic treatments based on novel technologies is unproven and may not result in marketable products.

We plan to develop subcutaneously delivered RNAi-based pharmaceuticals using our GalXC RNAi platform for the treatment of rare diseases involving the liver and for other therapeutic areas involving the liver such as chronic liver diseases, as well as cardiometabolic diseases and viral infectious diseases. We believe that product candidates identified with our drug discovery and delivery platform may offer an improved therapeutic approach to small molecules and monoclonal antibodies, as well as several advantages over earlier generation RNAi molecules. However, the scientific research that forms the basis of our efforts to develop product candidates is relatively new. The scientific evidence to support the feasibility of developing therapeutic treatments based on RNAi and GalXC is both preliminary and limited.

Relatively few product candidates based on RNAi have been tested in animals or humans, and a number of clinical trials conducted by other companies using RNAi technologies have not been successful. We may discover that GalXC does not possess certain properties required for a drug to be safe and effective, such as the ability to remain stable in the human body for the period of time required for the drug to reach the target tissue or the ability to cross the cell wall and enter into cells within the target tissue for effective delivery. We currently have only limited data, and no conclusive evidence, to suggest that we can introduce these necessary drug-like properties into GalXC. We may spend substantial funds attempting to introduce these properties and may never succeed in doing so. In addition, product candidates based on GalXC may demonstrate different chemical and pharmacological properties in patients than they do in laboratory studies. Even if product candidates, such as nedosiran (formerly DCR-PHXC), RG6346 (formerly DCR-HBVS), and DCR-A1AT, have successful results in animal studies, they may not demonstrate the same chemical and pharmacological properties in humans and may interact with human biological systems in unforeseen, ineffective, or harmful ways. As a result, we may never succeed in developing a marketable product, we may not become profitable, and the value of our common stock will decline.

Further, the United States ("U.S.") Food and Drug Administration ("FDA") has relatively limited experience with RNAi or GalXC-based therapeutics. We and our current collaborators, or any future collaborators, may never receive approval to market and commercialize any product candidate. Even if we or a collaborator obtain regulatory approval, the approval may be for disease indications or patient populations that are not as broad as we intended or desired or may require labeling that includes significant use or distribution restrictions or safety warnings. We or a collaborator may be required to perform additional or unanticipated clinical trials to obtain approval or be subject to post-marketing testing requirements to maintain regulatory approval. If our technologies based on GalXC prove to be ineffective, unsafe, or commercially unviable, our entire platform and pipeline would have little, if any, value, which would have a material adverse effect on our business, financial condition, results of operations, and prospects.

The market may not be receptive to our product candidates based on a novel therapeutic modality, and we may not generate any future revenue from the sale or licensing of product candidates.

Even if approval is obtained for a product candidate, we may not generate or sustain revenue from sales of the product due to numerous factors, including whether the product can be sold at a competitive price and otherwise is accepted in the market. The product candidates that we are developing are based on new technologies and therapeutic approaches. Market participants with significant influence over acceptance of new treatments, such as physicians and third-party payors, may not adopt a treatment based on GalXC technology, and we may not be able to convince the medical community and third-party payors, including health insurers, to accept and use, or to provide favorable coverage of or reimbursement for, any product candidates developed by us or our existing collaborator or any future collaborators. Market acceptance of our product candidates will depend on, among other factors:

- the timing of our receipt of any marketing and commercialization approvals and those of our competitors;

- the terms of any approvals and the countries in which approvals are obtained;
- the safety and efficacy of our product candidates;
- the prevalence and severity of any adverse side effects associated with our product candidates;
- limitations or warnings contained in any labeling approved by the FDA or other regulatory authority;
- relative convenience and ease of administration of our product candidates;
- the willingness of physicians and patients to accept any new methods of administration;
- the success of our physician education programs;
- the availability of adequate government and third-party payor coverage and reimbursement;
- the pricing of our products, particularly as compared to alternative treatments and the recommendations of public or private pricing review agencies or organizations regarding our products;
- our ability to market and sell our products in compliance with applicable law; and
- availability of alternative effective treatments for the disease indications our product candidates are intended to treat and the relative risks, benefits, and costs of those treatments.

With our focus on the emerging therapeutic modality RNAi, these risks may increase to the extent the market becomes more competitive or less favorable to this approach. Additional risks apply to any disease indications we pursue which are for rare diseases. Because of the small patient population for a rare disease, if pricing is not approved or accepted in the market at an appropriate level for an approved rare disease product, such drug may not generate enough revenue to offset costs of development, manufacturing, marketing, and commercialization, despite any benefits received from our efforts to obtain orphan drug designation by regulatory agencies in major commercial markets, such as the U.S., the European Union (“EU”), and Japan. These benefits may include market exclusivity, assistance in clinical trial design, or a reduction in user fees or tax credits related to development expense. Market size is also a variable in disease indications that are not classified as rare. Our estimates regarding potential market size for any indication may be materially different from what we discover to exist if we ever get to the point of product commercialization, which could result in significant changes in our business plan and have a material adverse effect on our business, financial condition, results of operations, and prospects.

If a product candidate that has orphan drug designation subsequently receives the first FDA approval for the indication for that designation, the product candidate is entitled to orphan product exclusivity, which means that the FDA may not approve any other applications to market the same drug for the same indication, except in very limited circumstances, for seven years. Orphan drug exclusivity, however, could also block the approval of one of our product candidates for seven years if a competitor obtains approval of the same drug for the same indication as defined by the FDA.

Even if we, or any future collaborators, obtain orphan drug exclusivity for a product, that exclusivity may not effectively protect the product from competition because different drugs can be approved for the same condition. Even after an orphan drug is approved, the FDA can subsequently approve the same drug for the same condition if the FDA concludes that the later drug is clinically superior in that it is shown to be safer, more effective, or makes a major contribution to patient care.

On August 3, 2017, the Congress passed the FDA Reauthorization Act of 2017 (“FDARA”). FDARA, among other things, codified the FDA’s preexisting regulatory interpretation, to require that a drug sponsor demonstrate the clinical superiority of an orphan drug that is otherwise the same as a previously approved drug for the same rare disease in order to receive orphan drug exclusivity. The law reverses prior precedent holding that the Orphan Drug Act unambiguously requires that the FDA recognize the orphan exclusivity period regardless of a showing of clinical superiority. The FDA may further reevaluate the Orphan Drug Act and its regulations and policies. We do not know if, when, or how the FDA may change the orphan drug regulations and policies in the future, and it is uncertain how any changes might affect our business. Depending on what changes the FDA may make to its orphan drug regulations and policies, our business could be adversely impacted.

As in the U.S., we may apply for designation of a product candidate as an orphan drug for the treatment of a specific indication in the EU before the application for marketing authorization is made. For example, in August 2018, the European Medicines Agency (“EMA”)’s Committee for Orphan Medicinal Products (“COMP”) designated nedosiran (formerly DCR-PHXC) as an orphan medicinal product for the treatment of PH in the EU. In December 2019, the European Commission granted orphan drug designation to DCR-A1AT for the treatment of congenital A1AT deficiency based on a positive opinion from the COMP of the EMA. Sponsors of orphan drugs in the EU can enjoy economic and marketing benefits, including up to 10 years of market exclusivity for the approved indication. During such period, marketing authorization applications for a “similar medicinal product” will not be accepted, unless another applicant can show that its product is safer, more effective, or otherwise clinically superior to the orphan-designated product. In the EU, a “similar medicinal product” is a medicinal product containing a similar active substance or substances as contained in a

currently authorized orphan medicinal product, and which is intended for the same therapeutic indication. The respective orphan designation and exclusivity frameworks in the U.S. and in the EU are subject to change, and any such changes may affect our ability to obtain U.S. or EU orphan designations in the future.

Our product candidates are in varied stages of development, including some in early stages, and may fail or suffer delays that materially and adversely affect their commercial viability.

We currently have no products on the market and our product candidates are in varied stages of development. Our ability to achieve and sustain profitability depends on obtaining regulatory approvals, including ethics committee approval, to conduct clinical trials at particular sites, successfully completing our clinical trials, and successfully commercializing our product candidates, either alone or with third parties, such as our collaborators. Before obtaining regulatory approval for the commercial distribution of our product candidates, we or a collaborator must conduct extensive preclinical tests and clinical trials to demonstrate the safety and efficacy of our product candidates in humans. Preclinical testing and clinical trials are expensive, difficult to design and implement, can take many years to complete, and are uncertain as to outcome. The start or end of a clinical study is often delayed or halted due to changing regulatory requirements, manufacturing challenges, required clinical trial administrative actions, slower than anticipated patient enrollment, changing standards of care, availability or prevalence of use of a comparative drug or required prior therapy, clinical outcomes, and financial constraints. For instance, delays or difficulties in patient enrollment or difficulties in retaining trial participants can result in increased costs, longer development times, or termination of a clinical trial. Clinical trials of a new product candidate require the enrollment of a sufficient number of patients, including patients who are suffering from the disease the product candidate is intended to treat and who meet other eligibility criteria. Rates of patient enrollment are affected by many factors, including the size of the patient population, the eligibility criteria for the clinical trial, the age and condition of the patients, the stage and severity of disease, the nature of the protocol, the proximity of patients to clinical sites, and the availability of effective treatments for the relevant disease. Thus, enrollment of sufficient patients can be challenging for rare disease drug development programs where patient populations are inherently small in size, particularly when there are competitive clinical trials.

A product candidate can unexpectedly fail at any stage of preclinical and clinical development. The historical failure rate for product candidates is high due to many factors, including scientific feasibility, safety, efficacy, and changing standards of medical care. The results from preclinical testing or early clinical trials of a product candidate may not predict the results that will be obtained in later phase clinical trials of the product candidate. We, the FDA or other applicable regulatory authorities, an individual Institutional Review Board (“IRB”) with respect to its institution, or an independent ethics committee may suspend clinical trials of a product candidate at any time for various reasons, including a belief that individuals participating in such trials are being exposed to unacceptable health risks or adverse side effects. We may not have the financial resources to continue development of, or to enter into collaborations for, a product candidate if we experience any problems or other unforeseen events that delay or prevent regulatory approval of, or our ability to commercialize, product candidates, including:

- negative or inconclusive results from our clinical trials or the clinical trials of others for product candidates similar to ours, leading to a decision or requirement to conduct additional preclinical testing or clinical trials or abandon a program;
- serious and unexpected drug-related side effects experienced by participants using our products in our clinical trials or by individuals using drugs similar to our product candidates;
- delays in submitting INDs or comparable foreign applications or delays or failures in obtaining the necessary approvals from regulators or IRBs to commence a clinical trial, or a suspension or termination of a clinical trial once commenced;
- conditions imposed by the FDA or comparable foreign authorities, such as the European Medicines Agency (“EMA”), regarding the scope or design of our clinical trials;
- competition for subjects in competitive clinical trials and delays in enrolling individuals in clinical trials;
- high drop-out rates of study participants;
- inadequate supply or quality of drug product or product candidate components or materials or other supplies necessary for the conduct of our clinical trials;
- greater than anticipated clinical trial costs;
- poor effectiveness of our product candidates during clinical trials;
- unfavorable FDA or other regulatory agency inspection and review of a clinical trial site;
- failure of our third-party contractors or investigators to comply with regulatory requirements or otherwise meet their contractual obligations in a timely manner, or at all;

- delays and changes in regulatory requirements, policy and guidelines, including the imposition of additional regulatory oversight around clinical testing generally or with respect to our technology in particular; and
- varying interpretations of data by the FDA and foreign regulatory agencies.

Breakthrough Therapy Designation by the FDA may not actually lead to a faster development or regulatory review or approval process.

The FDA has granted Breakthrough Therapy Designation to nedosiran for the treatment of patients with primary hyperoxaluria type 1 ("PH1"). A breakthrough therapy is defined as a drug that is intended, alone or in combination with one or more other drugs, to treat a serious or life-threatening disease or condition, and preliminary clinical evidence indicates that the drug may demonstrate substantial improvement over currently approved therapies on one or more clinically significant endpoints, such as substantial treatment effects observed early in clinical development. The FDA will work closely with us to provide guidance on subsequent development of nedosiran for treatment of PH1 to help us design and conduct a development program as efficiently as possible. For drugs that have been designated as breakthrough therapies, interaction and communication between the FDA and the sponsor of the trial can help to identify the most efficient path for clinical development while minimizing the number of patients placed in ineffective control regimens. Drugs designated as breakthrough therapies by the FDA are also eligible for accelerated approval and priority review.

Designation as a breakthrough therapy is within the discretion of the FDA. Accordingly, even if we believe a product candidate we develop meets the criteria for designation as a breakthrough therapy, the FDA may disagree and instead determine not to make such designation. In any event, the receipt of Breakthrough Therapy Designation may not result in a faster development process, review, or approval compared to drugs considered for approval under conventional FDA procedures and does not assure ultimate approval by the FDA. In addition, even if a product candidate qualifies as a breakthrough therapy, the FDA may later decide that the drug no longer meets the conditions for qualification and rescind the Breakthrough Therapy Designation. If the Breakthrough Therapy Designation for nedosiran for treatment of PH1 is rescinded, submission of portions of the NDA will not be permitted under this program.

We are dependent on our collaboration partners for the successful development of product candidates and, therefore, are subject to the efforts of these partners and our ability to successfully collaborate with these partners.

We have entered into collaboration agreements with Novo Nordisk A/S ("Novo"), F. Hoffmann-La Roche Ltd and Hoffmann-La Roche Inc. (together, "Roche"), Eli Lilly and Company ("Lilly"), Alexion Pharmaceuticals, Inc. (together with its affiliates, "Alexion"), and Boehringer Ingelheim International GmbH ("BI") (collectively, our "Collaboration Partners") providing joint development of certain RNAi therapies. The success of our collaborations with our Collaboration Partners and the realization of the milestone and royalty payments under the collaboration agreements depends upon the efforts of our Collaboration Partners, any of which may not be successful in obtaining approvals for the product candidates developed under the collaboration or in marketing, or arranging for necessary supply, manufacturing, or distribution relationships for, any approved products. Our Collaboration Partners may change their strategic focus or pursue alternative technologies in a manner that results in reduced, delayed, or no additional payments to us under the collaboration agreements. Our Collaboration Partners have a variety of marketed products and product candidates under collaboration with other companies, possibly including some of our competitors, and our Collaboration Partners' own corporate objectives may not be consistent with our interests. If our Collaboration Partners fail to develop, obtain regulatory approval for, or ultimately commercialize any product candidate under our collaborations, or if any of our Collaboration Partners terminates their applicable collaboration, our business, financial condition, results of operations, and prospects could be materially and adversely affected. Each of our collaboration agreements is terminable by the applicable collaboration partner any time at will, subject to compliance with applicable notice periods. In addition, if we have a dispute or enter into litigation with any of our Collaboration Partners in the future, it could delay development programs, create uncertainty as to ownership of intellectual property rights, distract management from other business activities, and generate substantial expense.

If third parties on which we depend to conduct our preclinical studies, or any future clinical trials, do not perform as contractually required, fail to satisfy regulatory or legal requirements, or miss expected deadlines, our development program could be delayed with materially adverse effects on our business, financial condition, results of operations, and prospects.

We rely on third-party clinical investigators, contract research organizations ("CROs"), clinical data management organizations, and consultants to design, conduct, supervise, and monitor preclinical studies of our product candidates and will do the same for any clinical trials. Because we rely on third parties and do not have the ability to conduct preclinical studies or clinical trials independently, we have less control over the timing, quality, compliance, and other aspects of preclinical studies and clinical trials than we would if we conducted them on our own. These investigators, CROs, and consultants are not our employees and we have limited control over the amount of time and resources that they dedicate to our programs. These third parties may have contractual relationships with other entities, some of which may be our competitors, which may draw time and resources from our programs. The

third parties with which we contract might not be diligent, careful, compliant, or timely in conducting our preclinical studies or clinical trials, resulting in the preclinical studies or clinical trials being delayed or unsuccessful.

If we cannot contract with acceptable third parties on commercially reasonable terms, or at all, or if these third parties do not carry out their contractual duties, satisfy legal and regulatory requirements for the conduct of preclinical studies or clinical trials, or meet expected deadlines, our clinical development programs could be delayed and otherwise adversely affected. In all events, we are responsible for ensuring that each of our preclinical studies and clinical trials is conducted in accordance with the general investigational plan and protocols for the trial as well as applicable laws and regulations. The FDA and certain foreign regulatory authorities, such as the EMA, require preclinical studies to be conducted in accordance with applicable good laboratory practices and clinical trials to be conducted in accordance with applicable FDA regulations and applicable good clinical practices, including requirements for conducting, recording, and reporting the results of preclinical studies and clinical trials to assure that data and reported results are credible and accurate and that the rights, integrity, and confidentiality of clinical trial participants are protected. Our reliance on third parties that we do not control does not relieve us of these responsibilities and requirements. Any such event could have a material adverse effect on our business, financial condition, results of operations, and prospects.

Because we rely on third-party manufacturing and supply partners, our supply of research and development, preclinical studies, and clinical trial materials may become limited or interrupted or may not be of satisfactory quantity or quality.

We rely on third-party supply and manufacturing companies and organizations to supply the materials, components, and manufacturing services for our research and development, preclinical study, and clinical trial drug supplies. We do not own or lease manufacturing facilities or supply sources for such components and materials; however, we recently entered into an initial five-year agreement with a supplier for the development, manufacture, and supply of clinical and commercial product; this agreement allows for advance preferential scheduling to the manufacturing line. Our manufacturing requirements include oligonucleotides and custom amidites which we procure on a purchase order basis. In addition, for each product candidate, we typically contract with only one manufacturer for the formulation and filling of drug product. There can be no assurance that our supply of research and development, preclinical study, and clinical trial drugs and other materials will not be limited, interrupted, restricted in certain geographic regions, or of satisfactory quality, or continue to be available at acceptable prices. In particular, any replacement of our drug substance manufacturer could require significant effort and expertise because there may be a limited number of qualified replacements.

Although we have multiple contract manufacturers, two of our amidite manufacturers are based in China, and as a result of the recent outbreak of the *coronavirus*, there is an increased risk of supply interruption at those facilities. We are seeking to expand amidite production in other countries and to manufacture inventory to reduce this risk.

If we are at any time unable to provide an uninterrupted supply of our product candidates or, following regulatory approval, any products to patients, we may lose patients, physicians may elect to utilize competing therapeutics instead of our products, and our clinical trials may be adversely affected, which could materially and adversely affect our clinical trial outcomes.

The manufacturing process for a product candidate is subject to FDA and foreign regulatory authority review. Suppliers and manufacturers must meet applicable manufacturing requirements and undergo rigorous facility and process validation tests required by regulatory authorities in order to comply with regulatory standards such as cGMP. In the event that any of our suppliers or manufacturers fails to comply with such requirements or to perform its obligations regarding quality, timing or otherwise, or if our supply of components or other materials becomes limited or interrupted for other reasons, we may experience shortages resulting in delayed shipments, supply constraints and/or stock-outs of our products, be forced to manufacture the materials ourselves, for which we currently do not have the capabilities or resources, or enter into an agreement with another third party, which we may not be able to do on reasonable terms, if at all. In some cases, the technical skills or technology required to manufacture our product candidates may be unique or proprietary to the original manufacturer and we may have difficulty, or there may be contractual restrictions prohibiting us from, transferring such skills or technology to another third party and a feasible alternative may not exist. These factors would increase our reliance on such manufacturer or require us to obtain a license from such manufacturer in order to have another third party manufacture our product candidates. If we are required to change manufacturers for any reason, we will be required to verify that the new manufacturer maintains facilities and procedures that comply with quality standards and with all applicable regulations. The delays associated with the verification of a new manufacturer could negatively affect our ability to develop product candidates in a timely manner or within budget.

We expect to continue to rely on third-party manufacturers if we receive regulatory approval for any product candidate. To the extent that we have existing, or enter into future, manufacturing arrangements with third parties, we will depend on these third parties to perform their obligations in a timely manner consistent with contractual and regulatory requirements, including those related to quality control and assurance. If we are unable to obtain or maintain third-party manufacturing for product candidates, or to do so on commercially reasonable terms, we may not be able to develop and commercialize our product candidates successfully. Our or a third party’s failure to execute on our manufacturing requirements could adversely affect our business in a number of ways, including:

- an inability to initiate or continue preclinical studies or clinical trials of product candidates under development;

- delay in submitting regulatory applications, or receiving regulatory approvals, for product candidates;
- lack of or loss of the cooperation of a collaborator;
- subjecting manufacturing facilities of our product candidates to additional inspections by regulatory authorities;
- requirements to cease distribution or to recall batches of our product candidates; and
- in the event of approval to market and commercialize a product candidate, an inability to meet commercial demands for our products.

We may not successfully engage in strategic transactions, including any additional collaborations we seek, which could adversely affect our ability to develop and commercialize product candidates, impact our cash position, increase our expense, and present significant distractions to our management.

From time to time, we may consider strategic transactions, such as collaborations, acquisitions of companies, asset purchases, and out- or in-licensing of product candidates or technologies. In addition to our current collaborations with Novo, Roche, Lilly, Alexion, and BI, we will evaluate and, if strategically attractive, seek to enter into additional collaborations, including with major biopharmaceutical, biotechnology, or pharmaceutical companies. The competition for collaborators is intense, and the negotiation process is time-consuming and complex. Any new collaboration may be on terms that are not optimal for us, and we may be unable to maintain any existing or future collaboration if, for example, development or approval of a product candidate is delayed, sales of an approved product do not meet expectations, or the collaborator terminates the collaboration. Any such collaboration, or other strategic transaction, may require us to incur non-recurring or other charges, increase our near- and long-term expenditures, and pose significant integration or implementation challenges or disrupt our management or business. These transactions entail numerous operational and financial risks, including exposure to unknown liabilities, disruption of our business, and diversion of our management's time and attention in order to obtain and manage a collaboration or develop acquired products, product candidates, or technologies, incurrence of substantial debt or dilutive issuances of equity securities to pay transaction consideration or costs, higher than expected collaboration, acquisition, or integration costs, write-downs of assets or impairment charges, increased amortization expenses, difficulty and cost in facilitating the collaboration or combining the operations and personnel of any acquired business, deterioration of relationships with key suppliers, manufacturers, or customers of any acquired business due to changes in management and ownership and the inability to retain key employees of any acquired business. Accordingly, although there can be no assurance that we will undertake or successfully complete any transactions of the nature described above, any transactions that we do complete may be subject to the foregoing or other risks and have a material adverse effect on our business, results of operations, financial condition, and prospects. Conversely, failure to enter any collaboration or other strategic transaction that would be beneficial to us could delay the development and potential commercialization of our product candidates and have a negative impact on the competitiveness of any product candidate that reaches market.

We face competition from entities that have developed or may develop product candidates for our target disease indications, including companies developing novel treatments and technology platforms based on modalities and technology similar to ours. If these companies develop technologies or product candidates more rapidly than we do or their technologies, including delivery technologies, are more effective, our ability to develop and successfully commercialize product candidates may be adversely affected.

The development and commercialization of drugs is highly competitive. We compete with a variety of multinational pharmaceutical companies and specialized biotechnology companies, as well as technology being developed at universities and other research institutions. Our competitors have developed, are developing, or may develop product candidates and processes competitive with our product candidates, some of which may become commercially available before any of our product candidates. We believe that a significant number of products are currently under development and may become commercially available in the future for the treatment of conditions for which we may try to develop product candidates.

Competitive therapeutic treatments include those that have already been approved and accepted by the medical community and any new treatments that enter the market. We are aware of many companies that are working in the field of RNAi therapeutics, including major pharmaceutical companies and a number of biopharmaceutical companies including Alnylam, Arrowhead Pharmaceuticals, Inc. ("Arrowhead"), and Arbutus Biopharma Corporation ("Arbutus").

We also compete with companies working to develop antisense and other RNA-based drugs including Ionis Pharmaceuticals, Akcea Therapeutics, Inc., Moderna, Inc., and Wave Life Sciences Ltd. Like RNAi therapeutics, antisense drugs target mRNA with the objective of suppressing the activity of specific genes. The development of antisense drugs is more advanced than that of RNAi therapeutics with several antisense therapies currently approved, and antisense technology may become the preferred technology for products that target mRNAs.

Many of our competitors have significantly greater financial, technical, manufacturing, marketing, sales and supply resources or experience than we have. Some of our competitors may be in the lead in the development of competitive products. If we successfully obtain approval for any product candidate, we will face competition based on many different factors, including safety and effectiveness, ease with which our products can be administered, the timing of product entry into the market, the extent to which patients and physicians accept relatively new routes of administration, timing and scope of regulatory approvals, availability and cost of manufacturing, marketing and sales capabilities, price, reimbursement coverage, and patent position of our products. Competing products could present superior treatment alternatives, including by being more effective, safer, less expensive or marketed and sold more effectively than any products we may develop. Competitive products may make any products we develop obsolete or noncompetitive before we recover the expense of developing and commercializing our product candidates. Competitive products that enter the market before our products could capture significant market share and create barriers to entry to our products. Competitors could also recruit our employees, which could negatively impact our level of expertise and our ability to execute our business plan.

Beyond RNA-based platform competition, there are a number of potential competitors working to develop therapeutics in our areas of research, including Oxthera AB, Allena Pharmaceuticals, Inc., Vertex Pharmaceuticals, Inc., Assembly Biosciences, Inc., AbbVie, Inc., Gilead Sciences, Inc., Johnson & Johnson, and GlaxoSmithKline plc.

Any inability to attract and retain qualified key management and technical personnel would impair our ability to implement our business plan.

Our success largely depends on the continued service of key management and other specialized personnel, including: Douglas M. Fambrough, III, Ph.D., our chief executive officer; Bob D. Brown, Ph.D., our chief scientific officer; Ralf Rosskamp, M.D., our chief medical officer; James B. Weissman, our chief operating officer; and Rob Ciappenelli, our chief commercial officer. The loss of one or more members of our management team or other key employees or advisors could delay our research and development programs and materially harm our business, financial condition, results of operations, and prospects. The relationships that our key managers have cultivated within our industry make us particularly dependent upon their continued employment with us. We are dependent on the continued service of our technical personnel because of the highly complex nature of our product candidates and technologies and the specialized nature of the regulatory approval process. Because our management team and key employees are not obligated to provide us with continued service, they could terminate their employment with us at any time without penalty. We do not maintain key person life insurance policies on any of our management team members or key employees. Our future success will depend in large part on our continued ability to attract and retain other highly qualified scientific, technical, and management personnel, as well as personnel with expertise in clinical testing, manufacturing, governmental regulation, and commercialization. We face competition for personnel from other companies, universities, public and private research institutions, government entities, and other organizations.

Interim and preliminary data from our clinical trials that we announce or publish from time to time may change as more patient data become available or as additional analyses are conducted and as the data are subject to audit and verification procedures that could result in material changes in the final data.

From time to time, we may publish interim or preliminary data from our clinical studies. Interim data from clinical trials that we may complete are subject to the risk that one or more of the clinical outcomes may materially change as patient enrollment continues and more patient data become available. Preliminary data also remain subject to audit and verification procedures that may result in the final data being materially different from the preliminary data we previously published. As a result, interim and preliminary data should be viewed with caution until the final data are available. Material adverse changes between preliminary or interim data and final data could significantly harm our business prospects.

If our product candidates advance into clinical trials, we may experience difficulties in managing our growth and expanding our operations.

Compared to larger pharmaceutical companies, we have limited experience in drug development and with clinical trials of product candidates. As our product candidates enter and advance through preclinical studies and any clinical trials, we will need to expand our development, regulatory, and manufacturing capabilities or contract with other organizations to provide these capabilities for us. In the future, we expect to have to manage additional relationships with collaborators, contract research organizations, clinical trial sites, investigators, suppliers, and other firms. Our ability to manage our operations and future growth will require us to continue to improve our operational, financial, and management controls, reporting systems, and procedures. We may not be able to implement improvements to our management information and control systems in an efficient or timely manner and may discover deficiencies in existing systems and controls.

We or our collaborative partners may conduct clinical trials for product candidates outside of the U.S., and the FDA and comparable foreign regulatory authorities may not accept data from such trials.

We or our collaborative partners may in the future choose to conduct one or more clinical trials outside the U.S., including in Europe. For instance, our clinical trials of nedosiran, RG6346, and DCR-A1AT each include subjects outside of the U.S. The acceptance of study data from clinical trials conducted outside of the U.S. or another jurisdiction by the FDA or comparable foreign regulatory authority may be subject to certain conditions or may not be accepted at all. In cases where data from foreign clinical trials are intended to serve as the basis for marketing approval in the U.S., the FDA will generally not approve the application on the basis of foreign data alone unless (i) the data are applicable to the U.S. population and U.S. medical practice; and (ii) the trials were performed by clinical investigators of recognized competence and pursuant to GCP regulations. Additionally, the FDA's clinical trial requirements, including sufficient size of patient populations and statistical powering, must be met. Many foreign regulatory authorities have similar approval requirements. In addition, such foreign trials would be subject to the applicable local laws of the foreign jurisdictions where the trials are conducted. There can be no assurance that the FDA or any comparable foreign regulatory authority will accept data from trials conducted outside of the U.S. or the applicable international jurisdiction for which we plan to enroll subjects outside of the U.S. If the FDA or any comparable foreign regulatory authority does not accept such data, it would result in the need for additional trials, which would be costly and time-consuming and delay aspects of our business plan, and which may result in product candidates that we may develop not receiving approval or clearance for commercialization in the applicable jurisdiction.

If any of our product candidates are approved for marketing and commercialization and we are unable to develop sales, marketing, and distribution capabilities on our own or enter into agreements with third parties to perform these functions on acceptable terms, we will be unable to successfully commercialize any such future products.

We currently have limited sales, marketing, or distribution capabilities or experience. If any of our product candidates are approved, we will need to significantly expand and implement sales, marketing, and distribution capabilities to commercialize such products, which would be expensive and time-consuming, or enter into collaborations with third parties to perform these services. If we decide to market our products directly, we will need to commit significant financial, legal, and managerial resources to develop a marketing and sales force with technical expertise and supporting distribution, administration, and compliance capabilities. If we rely on third parties with such capabilities to market our approved products or decide to co-promote products with collaborators, we will need to establish and maintain marketing and distribution arrangements with third parties, and there can be no assurance that we will be able to enter into such arrangements on acceptable, compliant terms, or at all. In entering into third-party marketing or distribution arrangements, any commercial revenue we receive will depend upon the efforts of the third parties and there can be no assurance that such third parties will establish adequate sales and distribution capabilities or be successful in gaining market acceptance of any approved product. If we are not successful in commercializing any product approved in the future, either on our own or through third parties, our business, financial condition, results of operations, and prospects could be materially and adversely affected.

If we fail to comply with U.S. and foreign regulatory requirements, regulatory authorities could limit or withdraw any marketing or commercialization approvals we may receive and subject us to other penalties that could materially harm our business.

The Company, our product candidates, our suppliers, and our contract manufacturers, distributors, and contract testing laboratories are subject to extensive regulation by governmental authorities in the EU, the U.S., and other countries, with the regulations differing from country to country.

Even if we receive marketing and commercialization approval of a product candidate, we and our third-party service providers will be subject to continuing regulatory requirements, including a broad array of regulations related to establishment registration and product listing, manufacturing processes, risk management measures, quality and pharmacovigilance systems, post-approval clinical studies, labeling, advertising and promotional activities, record keeping, distribution, adverse event reporting, import and export of pharmaceutical products, pricing, sales and marketing, and fraud and abuse requirements. We are required to submit safety and other post-market information and reports and are subject to continuing regulatory review, including in relation to adverse patient experiences with the product and clinical results that are reported after a product is made commercially available, both in the U.S. and any foreign jurisdiction in which we seek regulatory approval. The FDA and certain foreign regulatory authorities, such as the EMA, have significant post-market authority, including the authority to require labeling changes based on new safety information and to require post-market studies or clinical trials to evaluate safety risks related to the use of a product or to require withdrawal of the product from the market. The FDA also has the authority to require a risk evaluation and mitigation strategy ("REMS") plan after approval, which may impose further requirements or restrictions on the distribution or use of an approved drug. The EMA now routinely requires risk management plans ("RMPs") as part of the marketing authorization application process, and such plans must be continually modified and updated throughout the lifetime of the product as new information becomes available. In addition, for nationally authorized medicinal products, the relevant governmental authority of any EU member state can request an RMP whenever there is a concern about a risk affecting the benefit risk balance of the product. The manufacturer and manufacturing facilities we use to make a future product, if any, will also be subject to periodic review and inspection by the FDA and other regulatory agencies, including for continued compliance with cGMP requirements. The discovery of any new or previously unknown problems with our third-party manufacturers, manufacturing processes, or facilities may result in restrictions on the product, manufacturer, or facility, including withdrawal of the product from the market. If we rely on third-party manufacturers, we will not have control over

compliance with applicable rules and regulations by such manufacturers. Any product promotion and advertising will also be subject to regulatory requirements and continuing regulatory review. If we or our collaborators, manufacturers, or service providers fail to comply with applicable continuing regulatory requirements in the U.S. or foreign jurisdictions in which we seek to market our products, we or they may be subject to, among other things, fines, warning and untitled letters, clinical holds, delay or refusal by the FDA or foreign regulatory authorities to approve pending applications or supplements to approved applications, suspension, refusal to renew or withdrawal of regulatory approval, product recalls, seizures or administrative detention of products, refusal to permit the import or export of products, operating restrictions, inability to participate in government programs including Medicare and Medicaid, and total or partial suspension of production or distribution, injunction, restitution, disgorgement, debarment, civil penalties, and criminal prosecution.

We face risks arising from the results of the public referendum held in the United Kingdom and its membership in the European Union.

We have a subsidiary located in the United Kingdom (the "UK"), which we established in order to allow us to conduct clinical trials in EU member states. On June 23, 2016, the UK held a referendum in which a majority of the eligible members of the electorate voted to leave the EU. The UK's withdrawal from the EU is commonly referred to as Brexit. Pursuant to Article 50 of the Treaty on European Union, the UK ceased being a Member State of the EU on January 31, 2020. However, the terms of the withdrawal have yet to be fully negotiated. The implementation period began February 1, 2020 and will continue until December 31, 2020. During this 11-month period, the UK will continue to follow all of the EU's rules and its trading relationship will remain the same. However, regulations (including financial laws and regulations, tax and free trade agreements, intellectual property rights, data protection laws, supply chain logistics, environmental, health and safety laws and regulations, medicine licensing and regulations, immigration laws and employment laws), have yet to be addressed. This lack of clarity on future UK laws and regulations and their interaction with EU laws and regulations may negatively impact foreign direct investment in the UK, increase costs, depress economic activity, and restrict access to capital. The uncertainty concerning the UK's legal, political, and economic relationship with the EU after Brexit may be a source of instability in the international markets, create significant currency fluctuations, and/or otherwise adversely affect trading agreements or similar cross-border co-operation arrangements (whether economic, tax, fiscal, legal, regulatory or otherwise) beyond the date of Brexit.

These developments, or the perception that any of them could occur, may have a significant adverse effect on global economic conditions and the stability of global financial markets, and could significantly reduce global market liquidity and limit the ability of key market participants to operate in certain financial markets. In particular, it could also lead to a period of considerable uncertainty in relation to the UK financial and banking markets, as well as on the regulatory process in Europe. Asset valuations, currency exchange rates, and credit ratings may also be subject to increased market volatility.

If the UK and the EU are unable to negotiate acceptable agreements or if other EU Member States pursue withdrawal, barrier-free access between the UK and other EU Member States or among the European Economic Area overall could be diminished or eliminated. The long-term effects of Brexit will depend on any agreements (or lack thereof) between the UK and the EU and, in particular, any arrangements for the UK to retain access to EU markets either during a transitional period or more permanently.

Such a withdrawal from the EU is unprecedented, and it is unclear how the UK's access to the European single market for goods, capital, services, and labor within the EU, or single market, and the wider commercial, legal, and regulatory environment, will impact our current and future operations (including business activities conducted by third parties and contract manufacturers on our behalf) and clinical activities in the UK. In addition to the foregoing, our UK operations support our current and future operations and clinical activities in other countries in the EU and European Economic Area ("EEA"), and these operations and clinical activities could be disrupted by Brexit.

We may also face new regulatory costs and challenges that could have an adverse effect on our operations. Depending on the terms of the UK's withdrawal from the EU, the UK could lose the benefits of global trade agreements negotiated by the EU on behalf of its members, which may result in increased trade barriers that could make our doing business in the EU and the EEA more difficult. Furthermore, at present, there are no indications of the effect Brexit will have on the pathway to obtaining marketing approval for any of our product candidates in the UK., or what, if any, role the EMA may have in the approval process. Even prior to any change to the UK's relationship with the EU, the announcement of Brexit has created economic uncertainty surrounding the terms of Brexit and its consequences could adversely impact customer confidence resulting in customers reducing their spending budgets on our solutions, which could adversely affect our business, revenue, financial condition, results of operations, and could adversely affect the market price of our common shares.

Price controls imposed in foreign markets and downward pricing pressure in the U.S. may adversely affect our future profitability.

In some countries, particularly member states of the EU, the pricing of prescription drugs may be subject to governmental control, at national as well as at regional levels. In these countries, pricing negotiations with governmental authorities can take considerable time after receipt of marketing approval for a product. In addition, in the U.S. and elsewhere, there can be considerable pressure by governments and other stakeholders on prices and reimbursement levels, including as part of cost containment measures. Political, economic, and regulatory developments may further complicate pricing and reimbursement negotiations, and pricing negotiations may continue after coverage or reimbursement has been obtained. Reference pricing used by various EU member states and parallel distribution, or arbitrage between low-priced and high-priced member states, can further reduce prices. In some countries, we or our collaborators may be required to conduct a clinical trial or other studies that compare the cost-effectiveness of our RNAi therapeutic candidates to other available therapies in order to obtain or maintain reimbursement or pricing approval. Publication of discounts by third-party payors or authorities may lead to further pressure on the prices or reimbursement levels within the country of publication and other countries. If reimbursement of any product candidate approved for marketing is unavailable or limited in scope or amount, or if pricing is set at unsatisfactory levels, our business, financial condition, results of operations, or prospects could be adversely affected.

Our business entails a significant risk of product liability and our ability to obtain sufficient insurance coverage could harm our business, financial condition, results of operations, or prospects.

Our business exposes us to significant product liability risks inherent in the development, testing, manufacturing, and marketing of therapeutic treatments. Product liability claims could delay or prevent completion of our development programs. If we succeed in marketing products, such claims could result in an investigation by certain regulatory authorities, such as the FDA or foreign regulatory authorities, of the safety and effectiveness of our products, our manufacturing processes and facilities, or our marketing programs and potentially a recall of our products or more serious enforcement action, limitations on the approved indications for which they may be used, or suspension or withdrawal of approvals. Regardless of the merits or eventual outcome, liability claims may also result in decreased demand for our products, injury to our reputation, costs to defend related litigation, a diversion of management's time and our resources, substantial monetary awards to clinical trial participants or patients, and a decline in our stock price. We currently have product liability insurance that we believe is appropriate for our stage of development and may need to obtain higher levels prior to marketing any of our product candidates. Any insurance we have or may obtain may not provide sufficient coverage against potential liabilities. Furthermore, clinical trial and product liability insurance is becoming increasingly expensive. As a result, we may be unable to obtain sufficient insurance at a reasonable cost to protect us against losses caused by product liability claims that could have a material adverse effect on our business.

Our employees may engage in misconduct or other improper activities, including noncompliance with regulatory standards and requirements, which could have a material adverse effect on our business.

We are exposed to the risk of employee fraud or other misconduct. Misconduct by employees could include, but is not limited to, intentional failures to comply with FDA or U.S. healthcare laws and regulations or applicable laws, regulations, guidance, or codes of conduct set by foreign governmental authorities or self-regulatory industry organizations, provide accurate information to any governmental authorities such as the FDA, comply with manufacturing standards we may establish, comply with federal and state healthcare fraud and abuse laws and regulations, report financial information or data accurately, or disclose unauthorized activities to us. In particular, sales, marketing, and business arrangements in the healthcare industry are subject to extensive laws, regulations, guidance, and codes of conduct intended to prevent fraud, kickbacks, self-dealing, and other abusive practices. These laws, regulations, guidance, and codes of conduct may restrict or prohibit a wide range of pricing, discounting, marketing and promotion, sales commission, customer incentive programs, business or conduct involving healthcare professionals, and other business arrangements. Employee misconduct could also involve the improper use of information obtained in the course of clinical trials, which could result in regulatory sanctions, including debarment or disqualification of those employees from participation in FDA-regulated activities, and serious harm to our reputation. It is not always possible to identify and deter employee misconduct, and any precautions we take to detect and prevent this activity may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from governmental investigations or other actions or lawsuits stemming from a failure to be in compliance with such laws, regulations, guidance, or codes of conduct. If any such actions are instituted against us, and we are not successful in defending ourselves or asserting our rights, those actions could have a significant impact on our business, including the imposition of significant fines, exclusion from government programs, or other sanctions.

Our internal computer systems, or those of third parties with which we do business, including our CROs or other contractors or consultants, may fail or suffer security breaches, which could result in a material disruption of our product development programs or the theft of Company or patient confidential information.

Despite the implementation of security measures, our internal computer systems and those of third parties with which we do business, including our CROs and other contractors and consultants, are vulnerable to damage from computer viruses, unauthorized

access, natural disasters, terrorism, war, and telecommunication and electrical failures. Such events, as well as power outages, natural disasters (including extreme weather), terrorist attacks, phishing or ransomware attacks, or other similar events, could cause interruptions of our operations.

In the ordinary course of our business, we collect and store sensitive data, including, among other things, legally protected patient health information, personally identifiable information about our employees, intellectual property, and proprietary business information. We manage and maintain our applications and data utilizing on-site systems and outsourced vendors. These applications and data encompass a wide variety of business-critical information, including research and development information, commercial information, and business and financial information. Because information systems, networks, and other technologies are critical to many of our operating activities, shutdowns or service disruptions at our company or vendors that provide information systems, networks, or other services to us pose increasing risks. Such disruptions may be caused by events such as computer hacking, phishing attacks, ransomware, dissemination of computer viruses, worms, and other destructive or disruptive software, denial of service attacks and other malicious activity, as well as power outages, natural disasters (including extreme weather), terrorist attacks or other similar events. Such events could have an adverse impact on us and our business, including loss of data and damage to equipment and data. In addition, system redundancy may be ineffective or inadequate, and our disaster recovery planning may not be sufficient to cover all eventualities. Significant events could result in a disruption of our operations, damage to our reputation, or a loss of revenues. In addition, we may not have adequate insurance coverage to compensate for any losses associated with such events. For instance, the loss of preclinical data or data from any future clinical trial involving our product candidates could result in delays in our development and regulatory filing efforts and significantly increase our costs.

We could be subject to risks caused by misappropriation, misuse, leakage, falsification or intentional or accidental release or loss of information maintained in the information systems and networks of our company and our vendors, including personal information of our employees and patients, and company and vendor confidential data. In addition, outside parties may attempt to penetrate our systems or those of our vendors or fraudulently induce our personnel or the personnel of our vendors to disclose sensitive information in order to gain access to our data and/or systems. We may experience threats to our data and systems, including malicious codes and viruses, phishing, and other cyber-attacks. The number and complexity of these threats continue to increase over time. If a material breach of our information technology systems or those of our vendors occurs, the market perception of its effectiveness of our security measures could be harmed and our reputation and credibility could be damaged. We could be required to expend significant amounts of money and other resources to repair or replace information systems or networks. Certain data breaches must also be reported to affected individuals and the government, and in some cases to the media, under provisions of the U.S. federal Health Insurance Portability and Accountability Act (“HIPAA”), as amended by the Health Information Technology for Economic and Clinical Health Act (“HITECH”), other U.S. federal and state law, and requirements of non-U.S. jurisdictions, including the European Union Data Protection Directive, and financial penalties may also apply. To the extent that any disruption or security breach were to result in a loss of, or damage to, internal computer systems, or those used by our CROs or other independent organizations, advisors, contractors or consultants, our data, or inappropriate disclosure of confidential or proprietary information of the Company or patients, we could incur liability, reputational harm, and the development of our product candidates could be delayed.

In addition, we could be subject to regulatory actions and/or claims made by individuals and groups in private litigation involving privacy issues related to data collection and use practices and other data privacy laws and regulations, including claims for misuse or inappropriate disclosure of data, as well as unfair or deceptive practices. Although we develop and maintain systems and controls designed to prevent these events from occurring, and we have a process to identify and mitigate threats, the development and maintenance of these systems, controls, and processes is costly and requires ongoing monitoring and updating as technologies change and efforts to overcome security measures become increasingly sophisticated. Moreover, despite our efforts, the possibility of these events occurring cannot be eliminated entirely. As we outsource more of our information systems to vendors, engage in more electronic transactions with payors and patients, and rely more on cloud-based information systems, the related security risks will increase and we may need to expend additional resources to protect our technology and information systems. In addition, there can be no assurance that our internal information technology systems or those of our third-party contractors, or our consultants’ efforts to implement adequate security and control measures, will be sufficient to protect us against breakdowns, service disruption, data deterioration or loss in the event of a system malfunction, or prevent data from being stolen or corrupted in the event of a cyberattack, security breach, industrial espionage attacks, or insider threat attacks which could result in financial, legal, business, or reputational harm.

If we do not comply with laws regulating the protection of the environment and health and human safety, our business could be adversely affected.

Our research, development, and manufacturing involve the use of hazardous materials and various chemicals. We maintain quantities of various flammable and toxic chemicals in our facility in Lexington, Massachusetts, that are required for our research, development, and manufacturing activities. We are subject to federal, state, and local laws and regulations governing the use, manufacture, storage, handling, and disposal of these hazardous materials. We believe our procedures for storing, handling, and disposing these materials in our Lexington facility comply with the relevant guidelines of Lexington, the Commonwealth of Massachusetts, and the Occupational Safety and Health Administration of the U.S. Department of Labor. Although we believe that our

safety procedures for handling and disposing of these materials comply with the standards mandated by applicable regulations, the risk of accidental contamination or injury from these materials cannot be eliminated. If an accident occurs, we could be held liable for resulting damages, which could be substantial. We are also subject to numerous environmental, health, and workplace safety laws and regulations, including those governing laboratory procedures, exposure to blood-borne pathogens, and the handling of animals and biohazardous materials. Although we maintain workers' compensation insurance to cover us for costs and expenses we may incur due to injuries to our employees resulting from the use of these materials, this insurance may not provide adequate coverage against potential liabilities. We do not maintain insurance for environmental liability or toxic tort claims that may be asserted against us in connection with our storage or disposal of biological or hazardous materials. Additional federal, state, and local laws and regulations affecting our operations may be adopted in the future. We may incur substantial costs to comply with, and substantial fines or penalties if we violate, any of these laws or regulations.

Our information technology systems could face serious disruptions that could adversely affect our business.

Despite the use of off-site (cloud-based) information storage systems for certain key corporate information, our internal information technology and other infrastructure systems, including corporate firewalls, servers, leased lines, and connection to the Internet, face the risk of systemic failure that could disrupt our operations. A significant disruption in the availability of our information technology and other internal infrastructure systems could cause interruptions in our collaborations and delays in our research and development work. While we qualify and seek to ensure our cloud-based information systems have appropriate cybersecurity and operations controls, we are dependent on third parties to assure their operations meet our information technology requirements.

Our current operations are largely concentrated in one location and any events affecting this location may have material adverse consequences.

Our current operations are carried out primarily in our facility located in Lexington, Massachusetts. Any unplanned event, such as flood, fire, explosion, earthquake, extreme weather condition, medical epidemics, power shortage, telecommunication failure, or other natural or manmade accidents, or incidents that prevent us from fully utilizing the facilities, may have a material adverse effect on our ability to operate our business, particularly on a daily basis, and have significant negative consequences on our financial and operating conditions. Loss of access to these facilities may result in increased costs, delays in the development of our product candidates, or interruption of our business operations. As part of our risk management policy, we maintain insurance coverage at levels that we believe are appropriate for our business. However, in the event of an accident or incident at these facilities, we cannot assure you that the amounts of insurance will be sufficient to satisfy any damages and losses. If our facilities are unable to operate because of an accident or incident or for any other reason, even for a short period of time, any or all of our research and development programs may be harmed. Any business interruption may have a material adverse effect on our business, financial position, results of operations, and prospects.

Our ability to utilize our net operating loss carryforwards and certain other tax attributes may be limited.

We have incurred substantial losses during our history, do not expect to become profitable for the foreseeable future, and may never achieve profitability. To the extent that we continue to generate taxable losses, unused losses will carry forward to offset future taxable income, if any, until such unused losses expire. We may be unable to use these losses to offset income before such unused losses expire. Under Section 382 of the Internal Revenue Code of 1986, as amended, if a corporation undergoes an "ownership change," which is generally defined as a greater than 50 percentage point change by value in its equity ownership over a three-year period, the corporation's ability to use its pre-change net operating loss carryforwards and other pre-change tax attributes to offset its post-change income may be further limited. We are in the process of performing an analysis on whether we have experienced any ownership changes in the past. Our preliminary analysis indicates that we may have experienced ownership changes in November 2007, October 2010, February 2014, and March 2018. While this analysis is still preliminary, it is likely that our net operating losses are subject to such limitation. As of December 31, 2019, we had significant U.S. federal and Massachusetts net operating loss carryforwards that could be reduced or lost if we have or do experience an ownership change, which could have an adverse effect on our business, financial position, results of operations, and prospects.

The investment of our cash, cash equivalents, and held-to-maturity investments is subject to risks which may cause losses and affect the liquidity of these investments.

As of December 31, 2019, we had $348.9 million in cash, cash equivalents, and held-to-maturity investments. We historically have invested substantially all of our available cash and cash equivalents in corporate bonds, commercial paper, securities issued by the U.S. government, certificates of deposit, and money market funds meeting the criteria of our investment policy, which is focused on the preservation of our capital. These investments are subject to general credit, liquidity, market, and interest rate risks. For example, the impact of U.S. sub-prime mortgage defaults in recent years affected various sectors of the financial markets and caused

credit and liquidity issues. We may realize losses in the fair value of these investments or a complete loss of these investments, which would have a negative effect on our consolidated financial statements.

In addition, should our investments cease paying or reduce the amount of interest paid to us, our interest income would suffer. The market risks associated with our investment portfolio may have an adverse effect on our results of operations, liquidity, and financial condition.

Changes in accounting rules and regulations, or interpretations thereof, could result in unfavorable accounting charges or require us to change our compensation policies.

Accounting methods and policies for public companies and biopharmaceutical companies, including policies governing revenue recognition, research and development and related expenses, and accounting for stock-based compensation, are subject to review, interpretation, and guidance from our auditors and relevant accounting authorities, including the SEC. Changes to accounting methods or policies, or interpretations thereof, may require us to reclassify, restate, or otherwise change or revise our consolidated financial statements, including those contained in our Annual Reports on Form 10-K.

Risks Related to Intellectual Property

If we are not able to obtain and enforce patent protection for our technologies or product candidates, development and commercialization of our product candidates may be adversely affected.

Our success depends in part on our ability to obtain and maintain patents and other forms of intellectual property rights, including in-licenses of intellectual property rights of others, for our product candidates, methods used to manufacture our product candidates and methods for treating patients using our product candidates, as well as our ability to preserve our trade secrets, to prevent third parties from infringing upon our proprietary rights, and to operate without infringing upon the proprietary rights of others. There can be no assurance that an issued patent will remain valid and enforceable in a court of law through the entire patent term. Should the validity of a patent be challenged, the legal process associated with defending the patent may be costly and time consuming. Issued patents can be subject to oppositions, interferences, post-grant proceedings, and other third-party challenges that can result in the revocation of the patent or limit patent claims such that patent coverage lacks sufficient breadth to protect subject matter that is commercially relevant. Competitors may be able to circumvent our patents. Development and commercialization of pharmaceutical products can be subject to substantial delays and it is possible that at the time of commercialization any patent covering the product will have expired or will be in force for only a short period of time thereafter.

As of December 31, 2019, our worldwide patent estate, not including the patents and patent applications that we have licensed from third parties, included at least 75 issued patents or allowed patent applications and over 175 pending patent applications supporting commercial development of our RNAi molecules and delivery technologies. We may not be able to apply for patents on certain aspects of our product candidates or delivery technologies in a timely fashion or at all. Our existing issued and granted patents and any future patents we obtain may not be sufficiently broad to prevent others from using our technology or from developing competing products and technology. There is no guarantee that any of our pending patent applications will result in issued or granted patents, that any of our issued or granted patents will not later be found to be invalid or unenforceable, or that any issued or granted patents will include claims that are sufficiently broad to cover our product candidates or delivery technologies or to provide meaningful protection from our competitors. Moreover, the patent position of biotechnology and pharmaceutical companies can be highly uncertain because it involves complex legal and factual questions. We will be able to protect our proprietary rights from unauthorized use by third parties only to the extent that our current and future proprietary technology and product candidates are covered by valid and enforceable patents or are effectively maintained as trade secrets. If third parties disclose or misappropriate our proprietary rights, it may materially and adversely impact our position in the market.

The U.S. Patent and Trademark Office (“USPTO”) and various foreign governmental patent agencies require compliance with a number of procedural, documentary, fee payment, and other provisions during the patent process. There are situations in which noncompliance can result in abandonment or lapse of a patent or patent application, resulting in partial or complete loss of patent rights in the relevant jurisdiction. In such an event, competitors might be able to enter the market earlier than would otherwise have been the case. The standards applied by the USPTO and foreign patent offices in granting patents are not always applied uniformly or predictably. For example, there is no uniform worldwide policy regarding patentable subject matter or the scope of claims allowable in biotechnology and pharmaceutical patents. As such, we do not know the degree of future protection that we will have on our proprietary products and technology. While we will endeavor to protect our product candidates with intellectual property rights such as patents, as appropriate, the process of obtaining patents is time-consuming, expensive, and sometimes unpredictable.

In addition, there are numerous recent changes to the patent laws and proposed changes to the rules of the USPTO which may have a significant impact on our ability to protect our technology and enforce our intellectual property rights. The U.S. Supreme Court

has ruled on several patent cases in recent years, some of which cases either narrow the scope of patent protection available in certain circumstances or weaken the rights of patent owners in certain situations. The 2013 decision by the U.S. Supreme Court in Association for Molecular Pathology v. Myriad Genetics, Inc. precludes a claim to a nucleic acid having a stated nucleotide sequence which is identical to a sequence found in nature and unmodified. We currently are not aware of an immediate impact of this decision on our patents or patent applications because we are developing nucleic acid products that are not found in nature. However, this decision has yet to be clearly interpreted by courts and by the USPTO. We cannot assure you that the interpretations of this decision or subsequent rulings will not adversely impact our patents or patent applications. In addition to increasing uncertainty with regard to our ability to obtain patents in the future, this combination of events has created uncertainty with respect to the value of patents, once obtained. Depending on decisions by the U.S. Congress, the federal courts, and the USPTO, the laws and regulations governing U.S. patents could change in unpredictable ways that would weaken our ability to obtain new patents or to enforce our existing patents and patents that we might obtain in the future.

Once granted, patents may remain open to opposition, interference, re-examination, post-grant review, *inter partes* review, nullification or derivation action in court or before patent offices or similar proceedings for a given period before or after allowance or grant, during which time third parties can raise objections against such initial grant. In the course of such proceedings, which may continue for a protracted period of time, the patent owner may be compelled to limit the scope of the allowed or granted claims thus attacked or may lose the allowed or granted claims altogether. Our patent risks include that:

- others may, or may be able to, make, use, or sell compounds that are the same as or similar to our product candidates but that are not covered by the claims of the patents that we own or license;
- we or our licensors, collaborators, or any future collaborators may not be the first to file patent applications covering certain aspects of our inventions;
- others may independently develop similar or alternative technologies or duplicate any of our technologies without infringing our intellectual property rights;
- a third party may challenge our patents, and, if challenged, a court may not hold that our patents are valid, enforceable, and infringed;
- a third party may challenge our patents in various patent offices, and, if challenged, we may be compelled to limit the scope of our allowed or granted claims or lose the allowed or granted claims altogether;
- any issued patents that we own or have licensed from others may not provide us with any competitive advantages, or may be challenged by third parties;
- we may not develop additional proprietary technologies that are patentable;
- the patents of others could harm our business; and
- our competitors could conduct research and development activities in countries where we will not have enforceable patent rights and then use the information learned from such activities to develop competitive products for sale in our major commercial markets.

Intellectual property rights of third parties could adversely affect our ability to commercialize our product candidates, and we might be required to litigate or obtain licenses from third parties in order to develop or market our product candidates. Such litigation could be costly and licenses may be unavailable on commercially reasonable terms.

Research and development of RNAi-based therapeutics and other oligonucleotide-based therapeutics has resulted in many patents and patent applications from organizations and individuals seeking to obtain patent protection in the field. Our efforts are based on RNAi technology that we have licensed and that we have developed internally and own or co-own. We have chosen this approach to increase our likelihood of technical success and our freedom to operate. We have obtained grants and issuances of RNAi-based patents and have licensed other patents from third parties on exclusive and non-exclusive bases. The issued patents and pending patent applications in the U.S. and in key markets around the world that we own, co-own, or license claim many different methods, compositions, and processes relating to the discovery, development, manufacture, and commercialization of RNAi therapeutics. Specifically, we own, co-own, or have licensed a portfolio of patents, patent applications, and other intellectual property covering: (1) certain aspects of the structure and uses of RNAi molecules, including their manufacture and use as therapeutics, and RNAi-related mechanisms, (2) chemical modifications to RNAi molecules that improve their properties and suitability for therapeutic uses, (3) RNAi molecules directed to specific gene sequences and drug targets as treatments for particular diseases, and (4) delivery technologies, such as in the field of lipid nanoparticles and lipid nanoparticle formulation, and chemical modifications such as conjugation to targeting moieties.

The RNAi-related intellectual property landscape, including patent applications in prosecution where no definitive claims have yet issued, is still evolving, and it is difficult to conclusively assess our freedom to operate. Other companies are pursuing patent

applications and possess issued patents broadly directed to RNAi compositions, methods of making and using RNAi, and to RNAi-related delivery and modification technologies. Our competitive position may suffer if patents issued to third parties cover our products, or our manufacture or uses relevant to our commercialization plans. In such cases, we may not be in a position to commercialize products unless we enter into a license agreement with the intellectual property right holder, if available, on commercially reasonable terms or successfully pursue litigation, opposition, interference, re-examination, post-grant review, *inter partes* review, nullification, derivation action, or cancellation proceeding to limit, nullify, or invalidate the third-party intellectual property right concerned. Even if we are successful in limiting, nullifying, or invalidating third-party intellectual property rights through such proceedings, we may incur substantial costs and could require significant time and attention of our personnel.

While we believe our intellectual property allows us to pursue our current development programs, the biological process of RNAi is a natural process and cannot be patented. Several companies in the space are pursuing alternate methods to exploit this phenomenon and have built their intellectual property around these methods. For example, Alnylam controls three patent families containing both pending patent applications and issued patents (e.g., U.S. Patent Numbers 8,853,384 and 9,074,213, and European Patent EP 1 352 061 B1) that pertain to RNAi. These are referred to in their corporate literature as the "Tuschl family" (e.g. patents and applications claiming priority to WO2002/044321, filed November 29, 2001, and their priority filings) and the "Kreutzer-Limmer family" (e.g., patents and applications claiming priority to WO 2000/044895, filed January 29, 2000, WO 2002/055693, filed January 9, 2002, and their priority filings). Both families contain patent applications still in prosecution, with the applicants actively seeking to extend the reach of this intellectual property in ways that might strategically impact our business. Additional areas of intellectual property pursued by Alnylam and others include oligonucleotide delivery-related technologies (such as conjugation to targeting moieties) and oligonucleotides directed to specific gene targets. In addition, Silence Therapeutics owns patents directed to certain chemical modifications of RNAi molecules, including U.S. Patent Number 9,222,092, with a priority date of August 5, 2002.

Patent applications in the U.S. and elsewhere are generally published approximately 18 months after the earliest filing for which priority is claimed, with such earliest filing date being commonly referred to as the priority date. Therefore, patent applications covering our product candidates or platform technology could have been filed by others without our knowledge. Additionally, pending claims in patent applications which have been published can, subject to certain limitations, be later amended in a manner that could cover our platform technologies, our product candidates, or the use of our product candidates. Third-party intellectual property right holders may also bring patent infringement claims against us. No such patent infringement actions have been brought against us. We cannot guarantee that we will be able to successfully settle or otherwise resolve any future infringement claims. If we are unable to successfully settle future claims on terms acceptable to us, we may be required to engage in or continue costly, unpredictable, and time-consuming litigation, and may be prevented from or experience substantial delays in marketing our products. If we fail in any such dispute, in addition to being forced to pay damages, we may be temporarily or permanently prohibited from commercializing any of our product candidates that are held to be infringing. We might also be forced to redesign product candidates so that we no longer infringe the third-party intellectual property rights. Any of these events, even if we were ultimately to prevail, could require us to divert substantial financial and management resources that we would otherwise be able to devote to our business.

As the field of RNAi therapeutics matures, patent applications are being processed by national patent offices around the world. There is uncertainty about which patents they will issue, and, if they do, as to when, to whom, and with what claims. It is likely that there will be significant litigation in the courts and other proceedings, such as interferences, re-examinations, oppositions, post-grant reviews, *inter partes* reviews, nullifications, derivation actions, or cancellation proceedings, in various patent offices relating to patent rights in the RNAi therapeutics field. In many cases, the possibility of appeal or opposition exists for either us or our opponents, and it may be years before final, unappealable rulings are made with respect to these patents in certain jurisdictions. The timing and outcome of these and other proceedings is uncertain and may adversely affect our business if we are not successful in defending the patentability and scope of our pending and issued patent claims or if third parties are successful in obtaining claims that cover our RNAi technology or any of our product candidates. In addition, third parties may attempt to invalidate our intellectual property rights. Even if our rights are not directly challenged, disputes could lead to the weakening of our intellectual property rights. Our defense against any attempt by third parties to circumvent or invalidate our intellectual property rights could be costly to us, could require significant time and attention of our management, and could have a material adverse effect on our business and our ability to successfully compete in the field of RNAi therapeutics.

There are many issued and pending patents that claim aspects of oligonucleotide chemistry and modifications that we may need to apply to our therapeutic candidates. There are also many issued patents that claim targeting genes or portions of genes that may be relevant for drugs we wish to develop. Thus, it is possible that one or more organizations will hold patent rights to which we will need a license. If those organizations refuse to grant us a license to such patent rights on reasonable terms, we may be unable to market products or perform research and development or other activities covered by these patents.

We may license patent rights from third-party owners or licensees. If such owners or licensees do not properly or successfully obtain, maintain, or enforce the patents underlying such licenses, or if they retain or license to others any competing rights, our competitive position and business prospects may be adversely affected.

We may, in the future, rely on intellectual property rights licensed from third parties to protect our technology, including licenses that give us rights to third-party intellectual property that is necessary or useful for our business. We also may license additional third-party intellectual property in the future. Our success may depend in part on the ability of our licensors to obtain, maintain, and enforce patent protection for our licensed intellectual property, in particular, those patents to which we have secured exclusive rights. Our licensors may not successfully prosecute the patent applications licensed to us. Even if patents issue or are granted, our licensors may fail to maintain these patents, such patents may have claim breadth coverage insufficient to protect our interests, may determine not to pursue litigation against other companies that are infringing these patents, or may pursue litigation less aggressively than we would. Further, we may not obtain exclusive rights, which would allow for third parties to develop competing products. Without protection for, or exclusive right to, the intellectual property we license, other companies might be able to offer substantially identical products for sale, which could adversely affect our competitive business position and harm our business prospects. In addition, we sublicense certain of our rights under our third-party licenses to BI and may sublicense such rights to current or future collaborators. Any impairment of these sublicensed rights could result in reduced revenue under our collaboration agreement with BI or result in termination of an agreement by one or more of our existing or any other future collaborators.

We may be unable to protect our intellectual property rights throughout the world.

Obtaining a valid and enforceable issued or granted patent covering our technology in the U.S. and worldwide can be extremely costly. In jurisdictions where we have not obtained patent protection, competitors may use our technology to develop their own products, and further, may export otherwise infringing products to territories where we have patent protection, but where it is more difficult to enforce a patent compared to the U.S. We also may face competition in jurisdictions where we do not have issued or granted patents or where our issued or granted patent claims or other intellectual property rights are not sufficient to prevent competitor activities in these jurisdictions. The legal systems of certain countries, particularly certain developing countries, make it difficult to enforce patents and such countries may not recognize other types of intellectual property protection, particularly that relating to biopharmaceuticals. This could make it difficult for us to prevent the infringement of our patents or marketing of competing products in violation of our proprietary rights generally in certain jurisdictions. Proceedings to enforce our patent rights in foreign jurisdictions could result in substantial cost and divert our efforts and attention from other aspects of our business.

We generally file a provisional patent application first (a priority filing) at the USPTO. A U.S. utility application and/or international application under the Patent Cooperation Treaty (“PCT”) are usually filed within 12 months after the priority filing. Based on the PCT filing, national and regional patent applications may be filed in the EU, Japan, Australia, and Canada and, depending on the individual case, also in any or all of, *inter alia*, China, India, South Korea, Singapore, Taiwan, and South Africa. We have so far not filed for patent protection in all national and regional jurisdictions where such protection may be available. In addition, we may decide to abandon national and regional patent applications before grant. Finally, the grant proceeding of each national or regional patent is an independent proceeding which may lead to situations in which applications might be refused in some jurisdictions, while granted by others. Depending on the country, various scopes of patent protection may be granted on the same product candidate or technology.

The laws of some jurisdictions do not protect intellectual property rights to the same extent as the laws in the U.S., and many companies have encountered significant difficulties in protecting and defending such rights in such jurisdictions. These difficulties could impact the future commercialization of our hepatitis B virus infection product candidate because a substantial share of the global market is in non-Western countries. If we or our licensors encounter difficulties in protecting, or are otherwise precluded from effectively protecting, the intellectual property rights important for our business in such jurisdictions, the value of these rights may be diminished and we may face additional competition from others in those jurisdictions. Many countries have compulsory licensing laws under which a patent owner may be compelled to grant licenses to third parties. In addition, many countries limit the enforceability of patents against government agencies or government contractors. In these countries, the patent owner may have limited remedies, which could materially diminish the value of such patent. If we or any of our licensors are forced to grant a license to third parties with respect to any patents relevant to our business, our competitive position in the relevant jurisdiction may be impaired and our business and results of operations may be adversely affected.

We, our licensors, or existing or future collaborators may become subject to third-party claims or litigation alleging infringement of patents or other proprietary rights or seeking to invalidate patents or other proprietary rights, and we may need to resort to litigation to protect or enforce our patents or other proprietary rights, all of which could be costly, time consuming, delay, or prevent the development and commercialization of our product candidates, or put our patents and other proprietary rights at risk.

We, our licensors, or existing or future collaborators may be subject to third-party claims for infringement or misappropriation of patent or other proprietary rights. We are generally obligated under our license or collaboration agreements to indemnify and hold

harmless our licensors or collaborators for damages arising from intellectual property infringement by us. If we, our licensors, or existing or future collaborators are found to infringe a third-party patent or other intellectual property rights, we could be required to pay damages, potentially including treble damages, if we are found to have willfully infringed. In addition, we, our licensors, or existing or future collaborators may choose to seek, or be required to seek, a license from a third party, which may not be available on acceptable terms, if at all. Even if a license can be obtained on acceptable terms, the rights may be non-exclusive, which could give our competitors access to the same technology or intellectual property rights licensed to us. If we fail to obtain a required license, we, our licensors, or existing or future collaborators may be unable to effectively market product candidates based on our technology, which could limit our ability to generate revenue or achieve profitability and possibly prevent us from generating revenue sufficient to sustain our operations. In addition, we may find it necessary to pursue claims or initiate lawsuits to protect or enforce our patent or other intellectual property rights. The cost to us in defending or initiating any litigation or other proceeding relating to patent or other proprietary rights, even if resolved in our favor, could be substantial, and litigation would divert our management's attention. Some of our competitors may be able to sustain the costs of complex patent litigation more effectively than we can because they have substantially greater resources. Uncertainties resulting from the initiation and continuation of patent litigation or other proceedings could delay our research and development efforts and limit our ability to continue our operations.

If we were to initiate legal proceedings against a third party to enforce a patent covering one of our products or our technology, the defendant could counterclaim that our patent is invalid or unenforceable. In patent litigation in the U.S., defendant counterclaims alleging invalidity or unenforceability are commonplace. Grounds for a validity challenge could be an alleged failure to meet any of several statutory requirements, for example, lack of novelty, obviousness, or non-enablement. Grounds for an unenforceability assertion could be an allegation that someone connected with prosecution of the patent withheld relevant information from the USPTO, or made a misleading statement, during patent prosecution. The outcome following legal assertions of invalidity and unenforceability during patent litigation is unpredictable. With respect to the validity question, for example, we cannot be certain that there is no invalidating prior art, of which we and the patent examiner were unaware during patent prosecution. If a defendant were to prevail on a legal assertion of invalidity or unenforceability, we would lose at least part, and perhaps all, of the patent protection on one or more of our products or certain aspects of our platform technology. Such a loss of patent protection could have a material adverse impact on our business. Patents and other intellectual property rights also will not protect our technology if competitors design around our protected technology without legally infringing our patents or other intellectual property rights.

If we fail to comply with our obligations under any license, collaboration, or other agreements, we may be required to pay damages and could lose intellectual property rights that are necessary for developing and protecting our product candidates and delivery technologies, or we could lose certain rights to grant sublicenses.

Any future licenses we enter are likely to impose various development, commercialization, funding, milestone, royalty, diligence, sublicensing, insurance, patent prosecution and enforcement, and other obligations on us. If we breach any of these obligations, or use the intellectual property licensed to us in an unauthorized manner, we may be required to pay damages, and the licensor may have the right to terminate the license, which could result in us being unable to develop, manufacture, and sell products that are covered by the licensed technology, or enable a competitor to gain access to the licensed technology. Moreover, our licensors may own or control intellectual property that has not been licensed to us and, as a result, we may be subject to claims, regardless of their merit, that we are infringing or otherwise violating the licensor's rights. In addition, while we cannot currently determine the amount of the royalty obligations we would be required to pay on sales of future products, if any, the amounts may be significant. The amount of our future royalty obligations will depend on the technology and intellectual property we use in products that we successfully develop and commercialize, if any. Therefore, even if we successfully develop and commercialize products, we may be unable to achieve or maintain profitability.

If we are unable to protect the confidentiality of our trade secrets, our business and competitive position would be harmed.

In addition to seeking patent protection for certain aspects of our product candidates and delivery technologies, we also consider trade secrets, including confidential and unpatented know-how, important to the maintenance of our competitive position. We protect trade secrets and confidential and unpatented know-how, in part, by entering into non-disclosure and confidentiality agreements with parties who have access to such knowledge, such as our employees, corporate collaborators, outside scientific collaborators, CROs, contract manufacturers, consultants, advisors, and other third parties. We also enter into confidentiality and invention or patent assignment agreements with our employees and consultants that obligate them to maintain confidentiality and assign their inventions to us. Despite these efforts, any of these parties may breach the agreements and disclose our proprietary information, including our trade secrets, and we may not be able to obtain adequate remedies for such breaches. Enforcing a claim that a party illegally disclosed or misappropriated a trade secret is difficult, expensive, and time-consuming, and the outcome is unpredictable. In addition, some courts in the U.S. and certain foreign jurisdictions are less willing or unwilling to protect trade secrets. If any of our trade secrets were to be lawfully obtained or independently developed by a competitor, we would have no right to prevent them from using that technology or information to compete with us. If any of our trade secrets were to be disclosed to or independently developed by a competitor, our competitive position would be harmed.

We are also subject both in the U.S. and outside the U.S. to various regulatory schemes regarding requests for the information we provide to regulatory authorities, which may include, in whole or in part, trade secrets or confidential commercial information. While we are likely to be notified in advance of any disclosure of such information and would likely object to such disclosure, there can be no assurance that our challenge to the request would be successful.

We may be, in the future, subject to claims that we or our employees or consultants have wrongfully used or disclosed alleged trade secrets of our employees' or consultants' former employers or their clients. These claims may be costly to defend and if we do not successfully do so, we may be required to pay monetary damages, may be prohibited from using some of our research and development work, and may lose valuable intellectual property rights or personnel.

Many of our employees were previously employed at universities or biotechnology or pharmaceutical companies, including our competitors or potential competitors. From time to time, we have received correspondence from other companies alleging the improper use or disclosure, or inquiring regarding the use or disclosure, by certain of our employees who have previously been employed elsewhere in our industry, including with our competitors, of their former employer's trade secrets or other proprietary information. Responding to these allegations can be costly and disruptive to our business, even when the allegations are without merit, and can be a distraction to management.

We may be subject to additional claims in the future that these or other employees of the Company have, or we have, inadvertently or otherwise used or disclosed trade secrets or other proprietary information of their former employers. Litigation may be necessary to defend against these claims. If we fail in defending current or future claims, in addition to paying monetary damages, we may lose valuable intellectual property rights, personnel, or the ability to use some of our research and development work. A loss of intellectual property, key research personnel, or their work product could hamper our ability to commercialize, or prevent us from commercializing, our product candidates, which could severely harm our business.

If our trademarks and trade names are not adequately protected, we may not be able to build name recognition in our markets of interest and our business may be adversely affected.

Our trademarks or trade names may be challenged, infringed, circumvented or declared generic, or determined to be infringing on other marks. Any trademark litigation could be expensive. We may not be able to protect our rights to these trademarks and trade names or may be forced to stop using these names, which we need for name recognition by potential collaborators or customers in our markets of interest. If we are unable to establish name recognition based on our trademarks and trade names, we may not be able to compete effectively, and our business may be adversely affected.

Risks Related to Government Regulation

We may be unable to obtain U.S. or foreign regulatory approval and, as a result, may be unable to commercialize our product candidates.

Our product candidates are subject to extensive governmental regulations relating to, among other things, research, development, testing, manufacture, quality control, approval, labeling, packaging, promotion, storage, record keeping, advertising, distribution, sampling, pricing, sales and marketing, safety, post-approval monitoring and reporting, and export and import of drugs. Rigorous preclinical testing and clinical trials and an extensive regulatory approval process are required to be successfully completed in the U.S. and in many foreign jurisdictions before a new drug can be marketed. Satisfaction of these and other regulatory requirements is costly, time consuming, uncertain, and subject to unanticipated delays. It is possible that none of the product candidates we may develop will obtain the regulatory approvals necessary for us or our collaborators to begin selling them.

We have limited experience in conducting and managing the clinical trials necessary to obtain regulatory approvals, including approval by the FDA as well as foreign regulatory authorities, such as the EMA. The time required to obtain FDA and foreign regulatory approvals is unpredictable but typically takes many years following the commencement of clinical trials, depending upon the type, complexity, and novelty of the product candidate. The standards that the FDA and its foreign counterparts use when regulating us are not always applied predictably or uniformly and can change. Any analysis we perform of data from preclinical and clinical activities is subject to confirmation and interpretation by regulatory authorities, which could delay, limit, or prevent regulatory approval. We may also encounter unexpected delays or increased costs due to new government regulations, for example, from future legislation or administrative action, or from changes in the policy of the FDA or foreign regulatory authorities during the period of product development, clinical trials, and regulatory review by the FDA or foreign regulatory authorities. It is impossible to predict whether legislative changes will be enacted, or whether FDA or foreign laws, regulations, guidance, or interpretations will be changed, or what the impact of such changes, if any, may be.

Because the drugs we are developing may represent a new class of drug, the FDA and its foreign counterparts have not yet established any definitive policies, practices, or guidelines in relation to these drugs. While we believe the product candidates that we are currently developing are regulated as new drugs under the Federal Food, Drug, and Cosmetic Act, the FDA could decide to reclassify them, namely to regulate them or other products we may develop as biologics under the Public Health Service Act. The lack of policies, practices, or guidelines may hinder or slow review by the FDA or foreign regulatory authorities of any regulatory filings that we may submit. Moreover, the FDA or foreign regulatory authorities may respond to these submissions by defining requirements we may not have anticipated. Such responses could lead to significant delays in the clinical development of our product candidates. In addition, because there may be approved treatments for some of the diseases for which we may seek approval, in order to receive regulatory approval, we may need to demonstrate through clinical trials that the product candidates we develop to treat these diseases, if any, are not only safe and effective, but safer or more effective than existing products.

Any delay or failure in obtaining required approvals could have a material adverse effect on our ability to generate revenues from the particular product candidate for which we are seeking approval. Furthermore, any regulatory approval to market a product may be subject to limitations on the approved uses for which we may market the product or the labeling or other restrictions. Regulatory authorities also may impose requirements for costly post-marketing studies or clinical trials and surveillance to monitor the safety or efficacy of the product. In addition, the FDA has the authority to require a REMS plan as part of an NDA or biologics license application or after approval, which may impose further requirements or restrictions on the distribution or use of an approved drug or biologic, such as limiting prescribing to certain physicians or medical centers that have undergone specialized training, limiting treatment to patients who meet certain safe-use criteria, and requiring treated patients to enroll in a registry. These limitations and restrictions may limit the size of the market for the product and affect coverage and reimbursement by third-party payors.

We are also subject to numerous foreign regulatory requirements governing, among other things, the conduct of clinical trials, manufacturing and marketing authorization, pricing, and third-party reimbursement. The foreign regulatory approval process varies among countries and may include all of the risks associated with FDA approval described above as well as risks attributable to the satisfaction of local regulations in foreign jurisdictions. Moreover, the time required to obtain approval may differ from that required to obtain FDA approval. Approval by the FDA does not ensure approval by regulatory authorities outside the U.S. and *vice versa*.

If we or current or future collaborators, manufacturers, or service providers fail to comply with healthcare laws and regulations, we or they could be subject to enforcement actions and substantial penalties, which could affect our ability to develop, market, and sell our products, and may harm our reputation.

Although we do not currently have any products on the market, if our therapeutic candidates or clinical trials are covered by federal healthcare programs or other third-party payors, we will be subject to additional healthcare statutory and regulatory requirements and enforcement by the federal, state, and foreign governments of the jurisdictions in which we conduct our business. Healthcare providers, physicians, and third-party payors play a primary role in the recommendation and prescription of any therapeutic candidates for which we may obtain marketing approval. Our future arrangements with third-party payors and customers may expose us to broadly applicable fraud and abuse, transparency, and other healthcare laws and regulations that may constrain the business or financial arrangements and relationships through which we market, sell, and distribute our therapeutic candidates for which we obtain marketing approval. Restrictions under applicable federal and state healthcare laws and regulations include, but are not limited to, the following:

- the federal Anti-Kickback Statute, which prohibits, among other things, persons from knowingly and willfully soliciting, receiving, offering, or providing remuneration, directly or indirectly, overtly or covertly, in cash or in kind, to induce or reward either the referral of an individual for a healthcare item or service, or the purchasing or ordering of an item or service, for which payment may be made, in whole or in part, under a federal healthcare program such as Medicare or Medicaid. This statute has been interpreted to apply to arrangements between pharmaceutical manufacturers on the one hand, and prescribers, purchases, and formulary managers, among other, on the other. A person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation;
- the federal civil and criminal false claims laws and civil monetary penalty laws, such as the U.S. federal False Claims Act (“FCA”), which imposes criminal and civil penalties, including through civil whistleblower or qui tam actions, against individuals or entities (including manufacturers) for, among other things, knowingly presenting or causing to be presented, to the federal government, claims for payment that are false or fraudulent, making, using, or causing to be made or used, a false statement or record material to payment of a false or fraudulent claim or obligation to pay or transmit money or property to the federal government; or knowingly concealing or knowingly and improperly avoiding, decreasing, or concealing an obligation to pay money to the federal government. The government may deem manufacturers to have “caused” the submission of false or fraudulent claims by, for example, providing inaccurate billing or coding information to customer or promoting a product off-label. In addition, the government may assert that a claim including items and services resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the FCA;

- HIPAA includes a fraud and abuse provision which imposes criminal and civil liability for knowingly and willfully executing, or attempting to execute, a scheme to defraud any healthcare benefit program (including private payors), or knowingly and willfully falsifying, concealing, or covering up a material fact or making any materially false statement in connection with the delivery of or payment for healthcare benefits, items, or services, regardless of the payor (e.g., public or private). Similar to the federal Anti-Kickback Statute, a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation;

- HIPAA, as amended by HITECH, and its implementing regulations, which impose obligations on certain covered entity healthcare providers, health plans, and healthcare clearinghouses, as well as their business associates that perform certain services involving the use or disclosure of individually identifiable health information, including mandatory contractual terms, with respect to safeguarding the privacy, security, and transmission of individually identifiable health information, and require notification to affected individuals and regulatory authorities of certain breaches of security of individually identifiable health information. HITECH also created new tiers of civil monetary penalties, amended HIPAA to make civil and criminal penalties directly applicable to business associates, and gave state attorneys general new authority to file civil actions for damages or injunctions in federal courts to enforce the federal HIPAA laws and seek attorneys' fees and costs associated with pursuing federal civil actions;

- federal and state consumer protection and unfair competition laws, which broadly regulate marketplace activities and activities that potentially harm consumers;

- the federal false statements statute which prohibits knowingly and willfully falsifying, concealing, or covering up a material fact or making any materially false statement in connection with the delivery of or payment for healthcare benefits, items, or services; similar to the federal Anti-Kickback Statute, a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation;

- the federal Physician Payment Sunshine Act created under the ACA, and its implementing regulations which require that manufacturers of drugs, biologicals, devices, and medical supplies for which payment is available under Medicare, Medicaid, and Children's Health Insurance Program (with certain exceptions) report annually to the Department of Health and Human Services information related to payments or other transfers of value made to physicians (defined to include doctors, dentists, optometrists, podiatrists, and chiropractors) and teaching hospitals, as well as ownership and investment interests held by physicians and their immediate family members. Effective January 1, 2022, these reporting obligations will extend to include transfers of value made to certain non-physician providers such as physician assistants and nurse practitioners;

- federal government price reporting laws, which require us to calculate and report complex pricing metrics in an accurate and timely manner to government programs;

- analogous state laws and regulations, such as state anti-kickback and false claims laws potentially applicable to sales or marketing arrangements and claims involving healthcare items or services reimbursed by nongovernmental third-party payors, including private insurers; and some state laws require pharmaceutical companies to comply with the pharmaceutical industry's voluntary compliance guidelines and the relevant compliance guidance promulgated by the federal government in addition to requiring drug manufacturers to report information related to payments to physicians and other healthcare providers or marketing expenditures, and state laws governing the privacy and security of health information in certain circumstances, many of which differ from each other in significant ways and often are not preempted by HIPAA, thus complicating compliance efforts;

- The Foreign Corrupt Practices Act ("FCPA") prohibits companies and their intermediaries from making, or offering or promising to make, improper payments to non-U.S. officials for the purpose of obtaining or retaining business or otherwise seeking favorable treatment;

- the EU General Data Protection Regulation (EU) 2016/679 ("GDPR"), which introduced new data protection requirements in the EU, as well as substantial fines for breaches of the data protection rules as of May 25, 2018. The GDPR enhances data protection obligations for processors and controllers of personal data, including, for example, expanded disclosures about how personal information is to be used, limitations on retention of information, mandatory data breach notification requirements, and onerous new obligations on services providers. Non-compliance with the GDPR may result in monetary penalties of up to €20 million or 4% of worldwide revenue, whichever is higher. The GDPR and other changes in laws or regulations associated with the enhanced protection of certain types of personal data, such as healthcare data or other sensitive information, could greatly increase our cost of providing our products and services or even prevent us from offering certain services in jurisdictions in which we operate;

- the California Consumer Privacy Act ("CCPA"), which creates new individual privacy rights for California consumers (as defined in the law) and places increased privacy and security obligations on entities handling personal data of consumers or households. The CCPA will require covered companies to provide certain disclosures to consumers about its data collection, use and sharing practices, and to provide affected California residents with ways to opt out of certain sales or transfers of personal information. The CCPA went into effect on January 1, 2020, and the California Attorney General will commence enforcement actions against violators beginning July 1, 2020. While there is currently an exception for protected health information that is subject to HIPAA and clinical trial regulations, as currently written, the CCPA may impact our business activities. The California Attorney General has proposed draft regulations, which have not been finalized to date, that may further impact our business activities if they are adopted.

The uncertainty surrounding the implementation of CCPA exemplifies the vulnerability of our business to the evolving regulatory environment related to personal data and protected health information; and

- federal consumer protection and unfair competition laws, which broadly regulate marketplace activities and activities that potentially harm consumers.

Additionally, we may be subject to state and non-U.S. equivalents of each of the healthcare laws described above, among others, some of which may be broader in scope and may apply regardless of the payor. The approval and commercialization of any of our drug candidates outside the U.S. will also likely subject us to non-U.S. equivalents of the healthcare laws mentioned above, among other non-U.S. laws.

The scope and enforcement of each of these laws is uncertain and subject to rapid change in the current environment of healthcare reform, especially in light of the lack of applicable precedent and regulations. Federal and state enforcement bodies have recently increased their scrutiny of interactions between healthcare companies and healthcare providers, which has led to a number of investigations, prosecutions, convictions, and settlements in the healthcare industry. Responding to investigations can be time and resource-consuming and can divert management's attention from the business. Any such investigation or settlement could increase our costs or otherwise have an adverse effect on our business.

Ensuring that our business arrangements with third parties comply with applicable healthcare laws and regulations could involve substantial costs. If our operations are found to be in violation of any such requirements, we may be subject to penalties, including civil or criminal penalties, monetary damages, the curtailment or restructuring of our operations, or exclusion from participation in government contracting, healthcare reimbursement, or other government programs, including Medicare and Medicaid, any of which could adversely affect our financial results. Although effective compliance programs can mitigate the risk of investigation and prosecution for violations of these laws, these risks cannot be entirely eliminated. Any action against us for an alleged or suspected violation could cause us to incur significant legal expenses and could divert our management's attention from the operation of our business, even if our defense is successful. In addition, achieving and sustaining compliance with applicable laws and regulations may be costly to us in terms of money, time, and resources.

If we or current or future collaborators, manufacturers, or service providers fail to comply with applicable federal, state, or foreign laws or regulations, we could be subject to enforcement actions, which could affect our ability to develop, market, and sell our products successfully and could harm our reputation and lead to reduced acceptance of our products by the market. These enforcement actions include, among others:

- adverse regulatory inspection findings;
- warning or untitled letters;
- voluntary or mandatory product recalls or public notification or medical product safety alerts to healthcare professionals;
- restrictions on, or prohibitions against, marketing our products;
- restrictions on, or prohibitions against, importation or exportation of our products;
- suspension of review or refusal to approve pending applications or supplements to approved applications, including due to pending enforcement actions or a finding of an enforcement action;
- exclusion from participation in government-funded healthcare programs;
- exclusion from eligibility for the award of government contracts for our products;
- a corporate integrity agreement;
- FDA debarment of individuals at our Company;
- suspension or withdrawal of product approvals;
- seizure or administrative detention of products;
- injunctions; and
- civil and criminal penalties and fines.

Any drugs we develop may become subject to unfavorable pricing regulations, third-party coverage, and reimbursement practices or healthcare reform initiatives, thereby harming our business.

The regulations that govern marketing approvals, pricing, coverage, and reimbursement for new drugs vary widely from country to country. Some countries require approval of the sale price of a drug before it can be marketed. In many countries, the

pricing review period begins after marketing or product licensing approval is granted. In some foreign markets, prescription pharmaceutical pricing remains subject to continuing governmental control even after initial approval is granted. Although we intend to monitor these regulations, our programs are currently in the early stages of development and we will not be able to assess the impact of price regulations for a number of years. As a result, we might obtain regulatory approval for a product in a particular country but then be subject to price regulations that delay our commercial launch of the product and negatively impact the revenues we are able to generate from the sale of the product in that country.

In the United States and markets in other countries, patients generally rely on third-party payors to reimburse all or part of the costs associated with their treatment. Adequate coverage and reimbursement from governmental healthcare programs, such as Medicare and Medicaid, and commercial payors is critical to new product acceptance. Our ability to commercialize any products successfully will also depend in part on the extent to which coverage and reimbursement for these products and related treatments will be available from government health administration authorities, private health insurers, and other organizations. Government authorities and third-party payors, such as private health insurers and health maintenance organizations, decide which medications they will pay for and establish reimbursement levels. The availability of coverage and extent of reimbursement by governmental and private payors is essential for most patients to be able to afford treatments. Sales of products that we may identify will depend substantially, both domestically and abroad, on the extent to which the costs of our product candidates will be paid by health maintenance, managed care, pharmacy benefit and similar healthcare management organizations, or reimbursed by government health administration authorities, private health coverage insurers and other third-party payors. However, there may be significant delays in obtaining coverage for newly approved drugs. Moreover, eligibility for coverage does not necessarily signify that a drug will be reimbursed in all cases or at a rate that covers our costs, including research, development, manufacture, sale, and distribution costs. Also, interim payments for new drugs, if applicable, may be insufficient to cover our costs and may not be made permanent. Thus, even if we succeed in bringing one or more products to the market, these products may not be considered medically necessary or cost-effective, and the amount reimbursed for any products may be insufficient to allow us to sell our products on a competitive basis. Because our programs are in the early stages of development, we are unable at this time to determine their cost effectiveness, or the likely level or method of reimbursement. In addition, obtaining coverage and reimbursement approval of a product from a government or other third-party payor is a time-consuming and costly process that could require us to provide to each payor supporting scientific, clinical, and cost-effectiveness data for the use of our product on a payor-by-payor basis, with no assurance that coverage and adequate reimbursement will be obtained. A payor's decision to provide coverage for a product does not imply that an adequate reimbursement rate will be approved. Further, one payor's determination to provide coverage for a product does not assure that other payors will also provide coverage for the product. Adequate third-party reimbursement may not be available to enable us to maintain price levels sufficient to realize an appropriate return on our investment in product development. If reimbursement is not available or is available only at limited levels, we may not be able to successfully commercialize any product candidate that we successfully develop.

Increasingly, the third-party payors who reimburse patients or healthcare providers, such as government and private insurance plans, are seeking greater upfront discounts, additional rebates, and other concessions to reduce the prices for pharmaceutical products. If the price we are able to charge for any products we develop, our product candidates are not considered medically necessary or cost effective, or the reimbursement provided for such products is inadequate in light of our development and other costs, our return on investment could be adversely affected.

We currently expect that certain drugs we develop may need to be administered under the supervision of a physician on an outpatient basis. Under currently applicable U.S. law, certain drugs that are not usually self-administered (including injectable drugs) may be eligible for coverage under Medicare through Medicare Part B. Specifically, Medicare Part B coverage may be available for eligible beneficiaries when the following, among other requirements have been satisfied:

- the product is reasonable and necessary for the diagnosis or treatment of the illness or injury for which the product is administered according to accepted standards of medical practice;
- the product is typically furnished incident to a physician's services;
- the indication for which the product will be used is included or approved for inclusion in certain Medicare-designated pharmaceutical compendia (when used for an off-label use); and
- the product has been approved by the FDA.

Average prices for drugs may be reduced by mandatory discounts or rebates required by government healthcare programs or private payors and by any future relaxation of laws that presently restrict imports of drugs from countries where they may be sold at lower prices than in the U.S. Reimbursement rates under Medicare Part B would depend in part on whether the newly approved product would be eligible for a unique billing code. Self-administered, outpatient drugs are typically reimbursed under Medicare Part D, and drugs that are administered in an inpatient hospital setting are typically reimbursed under Medicare Part A under a bundled payment. It is difficult for us to predict how Medicare coverage and reimbursement policies will be applied to our products in the

future and coverage and reimbursement under different federal healthcare programs are not always consistent. Medicare reimbursement rates may also reflect budgetary constraints placed on the Medicare program.

Third-party payors often rely upon Medicare coverage policies and payment limitations in setting their own reimbursement rates. These coverage policies and limitations may rely, in part, on compendia listings for approved therapeutics. Our inability to promptly obtain relevant compendia listings, coverage, and adequate reimbursement from both government-funded and private payors for new drugs that we develop and for which we obtain regulatory approval could have a material adverse effect on our operating results, our ability to raise capital needed to commercialize products, and our financial condition.

We expect that these and other healthcare reform measures that may be adopted in the future may result in more rigorous coverage criteria and lower reimbursement and in additional downward pressure on the price that we receive for any approved product. Any reduction in reimbursement from Medicare or other government-funded programs may result in a similar reduction in payments from private payors. The implementation of cost containment measures or other healthcare reforms may prevent us from being able to generate revenue, attain profitability, or commercialize our drugs once marketing approval is obtained. One example is the establishment in 2006 of the Institute for Clinical and Economic Review, or ICER. ICER evaluates the clinical and economic value of prescription drugs and issues reports for payors to rely on in making decisions on patient access to new medicines.

In addition, there has been increasing legislative and enforcement interest in the United States with respect to specialty drug pricing practices. Specifically, there have been several recent U.S. Congressional inquiries and proposed and enacted federal and state legislation designed to, among other things, bring more transparency to drug pricing, review the relationship between pricing and manufacturer patient assistance programs, and reform government program reimbursement methodologies for drugs. At the federal level, the U.S. President's administration's budget for fiscal year 2020 contains further drug price control measures that could be enacted during the 2020 legislative session or in other future legislation, including, for example, measures to permit Medicare Part D plans to negotiate the price of certain drugs under Medicare Part B, to allow some states to negotiate drug prices under Medicaid, and to eliminate cost sharing for generic drugs for low-income patients. Further, the current U.S. President's administration released a "Blueprint", or plan, to lower drug prices and reduce out of pocket costs of drugs that contains additional proposals to increase drug manufacturer competition, increase the negotiating power of certain federal healthcare programs, incentivize manufacturers to lower the list price of their products, and reduce the out of pocket costs of drug products paid by consumers. HHS has already started the process of soliciting feedback on some of these measures and, at the same, is immediately implementing others under its existing authority. For example, in May 2019, CMS issued a final rule to allow Medicare Advantage Plans the option of using step therapy, a type of prior authorization, for Part B drugs beginning January 1, 2020. This final rule codified CMS's policy change that was effective January 1, 2019. Although a number of these, and other proposed measures will require authorization through additional legislation to become effective, Congress and the current U.S. President's administration have each indicated that it will continue to seek new legislative and/or administrative measures to control drug costs. While some proposed measures will require authorization through additional legislation to become effective, Congress and the current U.S. President's administration have each indicated that it will continue to seek new legislative and/or administrative measures to control drug costs. For example, on September 25, 2019, the Senate Finance Committee introduced the Prescription Drug Pricing Reduction Action of 2019, a bill intended to reduce Medicare and Medicaid prescription drug prices. The proposed legislation would restructure the Part D benefit, modify payment methodologies for certain drugs, and impose an inflation cap on drug price increases. An even more restrictive bill, the Lower Drug Costs Now Act of 2019, was introduced in the House of Representatives on September 19, 2019 and would require HHS to directly negotiate drug prices with manufacturers. The Lower Drug Costs Now Act of 2019 has passed out of the House of Representatives and was delivered to the Senate on December 16, 2019. However, it is unclear whether either of these bills will make it through both chambers and be signed into law, and if either is enacted, what effect it would have on our business. Individual states in the United States have also become increasingly active in passing legislation and implementing regulations designed to control pharmaceutical product pricing, including price or patient reimbursement constraints, discounts, restrictions on certain product access and marketing cost disclosure and transparency measures, and, in some cases, designed to encourage importation from other countries and bulk purchasing.

We believe that the efforts of governments and third-party payors to contain or reduce the cost of healthcare and legislative and regulatory proposals to broaden the availability of healthcare will continue to affect the business and financial condition of pharmaceutical and biopharmaceutical companies. A number of legislative and regulatory changes in the healthcare system in the U.S. and other major healthcare markets have been proposed, and such efforts have expanded substantially in recent years. These developments could, directly or indirectly, affect our ability to sell our products, if approved, at a favorable price.

In 2010, the U.S. Congress passed the ACA, a sweeping law intended to broaden access to health insurance, reduce or constrain the growth of health spending, enhance remedies against fraud and abuse, add new transparency requirements for the healthcare and health insurance industries, impose new taxes and fees on the health industry, and impose additional policy reforms. Both the U.S. Congress and the U.S. President have expressed an intention to repeal or replace the ACA, and as a result, certain sections of the ACA have not been fully implemented or have been effectively repealed. The uncertainty around the future of the ACA and, in particular, the impact to reimbursement levels, may lead to uncertainty or delay in the purchasing decisions of our customers, which may in turn

negatively impact our product sales. If there are not adequate reimbursement levels, our business and results of operations could be adversely affected.

Among the provisions of the ACA addressing coverage and reimbursement of pharmaceutical products of importance to our potential therapeutic candidates are the following:

- increases to pharmaceutical manufacturer rebate liability under the Medicaid Drug Rebate Program due to an increase in the minimum basic Medicaid rebate on most branded prescription drugs and the application of Medicaid rebate liability to drugs used in risk-based Medicaid managed care plans;
- creates a new Medicare Part D coverage gap discount program, in which manufacturers must agree to offer 70% (increased pursuant to the Bipartisan Budget Act of 2018, effective as of 2019) point-of-sale discounts off negotiated prices of applicable brand drugs to eligible beneficiaries during their coverage gap period, as a condition for the manufacturer's outpatient drugs to be covered under Medicare Part D;
- the expansion of the 340B Drug Pricing Program to require discounts for "covered outpatient drugs" sold to certain children's hospitals, critical access hospitals, freestanding cancer hospitals, rural referral centers, and sole community hospitals;
- requirements imposed on pharmaceutical companies to offer discounts on brand-name drugs to patients who fall within the Medicare Part D coverage gap, commonly referred to as the "Donut Hole";
- requirements imposed on pharmaceutical companies to pay an annual non-tax-deductible fee to the federal government based on each company's market share of prior year total sales of branded drugs to certain federal healthcare programs, such as Medicare, Medicaid, Department of Veterans Affairs, and Department of Defense. Since we currently expect our branded pharmaceutical sales to constitute a small portion of the total federal healthcare program pharmaceutical market, we do not currently expect this annual assessment to have a material impact on our financial condition; and
- for products classified as biologics, marketing approval for a follow-on biologic product may not become effective until 12 years after the date on which the reference innovator biologic product was first licensed by the FDA, with a possible six-month extension for pediatric products. After this exclusivity ends, it may be possible for biosimilar manufacturers to enter the market, which is likely to reduce the pricing for the innovator product and could affect our profitability if our products are classified as biologics.

Despite initiatives to invalidate the Affordable Care Act, the U.S. Supreme Court has upheld certain key aspects of the legislation, including a tax-based shared responsibility payment imposed on certain individuals who fail to maintain qualifying health coverage for all or part of a year, which is commonly referred to as the "individual mandate." However, as a result of tax reform legislation passed in December 2017, the individual mandate has been eliminated effective January 1, 2019. On December 14, 2018, a U.S. District Court judge in the Northern District of Texas ruled that the individual mandate portion of the ACA is an essential and inseverable feature of the ACA, and therefore because the mandate was repealed as part of the Tax Cuts and Jobs Act, the remaining provisions of the ACA are invalid as well. On December 18, 2019, the Fifth Circuit U.S. Court of Appeals held that the individual mandate is unconstitutional and remanded the case to the lower court to reconsider its earlier invalidation of the ACA. Pending review, the ACA remains in effect, but it is unclear at this time what effect the latest ruling will have on the status of the ACA. Litigation and legislation over the ACA are likely to continue, with unpredictable and uncertain results. We will continue to evaluate the effect that the ACA and its possible repeal and replacement has on our business.

In addition, since January 2017, the U.S. President has signed two Executive Orders designed to delay the implementation of certain provisions of the ACA or otherwise circumvent some of the requirements for health insurance mandated by the ACA. Further, the current U.S. President's administration has concluded that Cost-Sharing Reduction ("CSR") payments to insurance companies required under the ACA have not received necessary appropriations from Congress and announced that it will discontinue these payments immediately until such appropriations are made. The loss of the CSR payments is expected to increase premiums on certain policies issued by qualified health plans under the ACA. Several state Attorneys General filed suit to stop the administration from terminating the subsidies, but their request for a restraining order was denied by a federal judge in California on October 25, 2017 and again on July 18, 2018. Furthermore, on June 14, 2018, the U.S. Court of Appeals for the Federal Circuit ruled that the federal government was not required to pay more than $12.0 billion in ACA risk corridor payments to third-party payors who argued were owed to them. On December 10, 2019, the U.S. Supreme Court heard arguments in *Moda Health Plan, Inc. v. United States*, which will determine whether the government must make risk corridor payments. The U.S. Supreme Court's decisions will be released in the coming months, but we cannot predict how the U.S. Supreme Court will rule. The effects of this gap in reimbursement on third-party payors, the viability of the ACA marketplace, providers, and potentially our business, are complex and not fully understood.

Other legislative changes have been proposed and adopted in the United States since the Affordable Care Act was enacted. In August 2011, the Budget Control Act of 2011, among other things, created measures for spending reductions by Congress. A Joint Select Committee on Deficit Reduction, tasked with recommending a targeted deficit reduction of at least $1.2 trillion for the years 2013 through 2021, was unable to reach required goals, thereby triggering the legislation's automatic reduction to several government programs. This includes aggregate reductions of Medicare payments to providers up to 2% per fiscal year, and, due to subsequent

legislative amendments, will remain in effect through 2029 unless additional Congressional action is taken. The American Taxpayer Relief Act of 2012 ("ATRA"), among other things, reduced Medicare payments to several providers, including hospitals, imaging centers, and cancer treatment centers, and increased the statute of limitations period for the government to recover overpayments to providers from three to five years. Moreover, on January 22, 2018, the U.S. President signed a continuing resolution on appropriations for fiscal year 2018 that delayed the implementation of certain ACA-mandated fees, including the so-called "Cadillac" tax on certain high cost employer-sponsored insurance plans, the annual fee imposed on certain health insurance providers based on market share, and the medical device excise tax on non-exempt medical devices; however, on December 20, 2019, the U.S. President signed into law the Further Consolidated Appropriations Act (H.R. 1865), which repeals the Cadillac tax, the health insurance provider tax, and the medical device excise tax. It is impossible to determine whether similar taxes could be instated in the future. Also, in 2018, the Trickett Wendler, Frank Mogiello, Jordan McLinn, and Matthew Bellina Right to Try Act of 2017 provided a federal framework for certain patients with life-threatening diseases to access certain investigational new drug products that have completed a Phase 1 clinical trial and that are undergoing investigation for FDA approval. Under certain circumstances, eligible patients can seek treatment without enrolling in clinical trials and without obtaining FDA permission under the FDA expanded access program. There is no obligation for a drug manufacturer to make its drug products available to eligible patients as a result of the Right to Try Act, but the manufacturer must develop an internal policy and respond to patient requests according to that policy.

From time to time, legislation is drafted, introduced, and passed in the U.S. Congress that could significantly change the statutory provisions governing coverage, reimbursement, and marketing of products regulated by CMS or other government agencies. In addition to new legislation, CMS coverage and reimbursement policies are often revised or interpreted in ways that may significantly affect our business and our products.

Our ability to obtain reimbursement or funding from the federal government may be impacted by possible reductions in federal spending.

U.S. federal government agencies currently face potentially significant spending reductions. The Budget Control Act of 2011 (the "BCA") established a Joint Select Committee on Deficit Reduction, which was tasked with achieving a reduction in the federal debt level of at least $1.2 trillion. That committee did not draft a proposal by the BCA's deadline. As a result, automatic cuts, referred to as sequestration, in various federal programs were scheduled to take place, beginning in January 2013, although the American Taxpayer Relief Act of 2012 delayed the BCA's automatic cuts until March 1, 2013. While the Medicare program's eligibility and scope of benefits are generally exempt from these cuts, Medicare payments to providers and Part D health plans are not exempt. The BCA did, however, provide that the Medicare cuts to providers and Part D health plans would not exceed two percent unless additional Congressional action is taken. President Obama issued the sequestration order on March 1, 2013, and cuts went into effect on April 1, 2013. Additionally, the Bipartisan Budget Act of 2015 extended sequestration for Medicare through fiscal year 2027.

More recently, there has been heightened governmental scrutiny over the manner in which manufacturers set prices for their marketed products, which have resulted in several recent Congressional inquiries and proposed bills designed to, among other things, bring more transparency to product pricing, review the relationship between pricing and manufacturer patient programs, and reform government program reimbursement methodologies for pharmaceutical products. Individual states in the U.S. have also become increasingly active in passing legislation and implementing regulations designed to control pharmaceutical product pricing, including price or patient reimbursement constraints, discounts, restrictions on certain product access and marketing cost disclosure and transparency measures, and, in some cases, designed to encourage importation from other countries and bulk purchasing.

The U.S. federal deficit reached an all-time high in 2019, and efforts to bring spending under control could, among other things, lead to cuts in Medicare payments to providers, as the Medicare program is frequently mentioned as a target for spending cuts. The full impact on our business of any future cuts in Medicare or other programs is uncertain. In addition, we cannot predict any impact President Trump's administration and the U.S. Congress may have on the federal budget. If federal spending is reduced, anticipated budgetary shortfalls may also impact the ability of relevant agencies, such as the FDA or the National Institutes of Health, to continue to function at current levels. Amounts allocated to federal grants and contracts may be reduced or eliminated. These reductions may also impact the ability of relevant agencies to timely review and approve drug research and development, manufacturing, and marketing activities, which may delay our ability to develop, market, and sell any products we may develop.

If any of our product candidates receive marketing approval and we or others later identify undesirable side effects caused by the product candidate, our ability to market and derive revenue from the product candidates could be compromised.

In the event that any of our product candidates receive regulatory approval and we or others identify undesirable side effects, adverse events, or other problems caused by one of our products, any of the following adverse events could occur, which could result in the loss of significant revenue to us and materially and adversely affect our results of operations and business:

- regulatory authorities may withdraw their approval of the product or seize the product;
- we may need to recall the product or change the way the product is administered to patients;

- additional restrictions may be imposed on the marketing of the particular product or the manufacturing processes for the product or any component thereof;
- we may not be able to secure or maintain adequate coverage and reimbursement for our proprietary product candidates from government (including U.S. federal healthcare programs) and private payors;
- we may be subject to fines, restitution or disgorgement of profits or revenues, injunctions, or the imposition of civil penalties or criminal prosecution;
- regulatory authorities may require the addition of labeling statements, such as a "black box" warning or a contraindication;
- regulatory authorities may require us to implement a REMS, or to conduct post-marketing studies or clinical trials and surveillance to monitor the safety or efficacy of the product; we may be required to create a Medication Guide outlining the risks of such side effects for distribution to patients;
- we could be sued and held liable for harm caused to patients;
- the product may become less competitive; and
- our reputation may suffer.

Risks Related to Our Common Stock

We no longer qualify as an "emerging growth company" and will be required to comply with certain provisions of the Sarbanes-Oxley Act and can no longer take advantage of reduced disclosure requirements.

Based on the market value of our common stock held by non-affiliates as of June 30, 2019, we no longer qualify as an "emerging growth company" as defined in the Jumpstart Our Business Startups Act ("JOBS Act") as of the year following December 31, 2019. As a result, we may incur additional and increasing costs to comply with our reporting and other obligations that we had not historically incurred due to our status as an emerging growth company or as a smaller reporting company. These costs include (1) being required to comply with the auditor attestation requirements of the Sarbanes-Oxley Act of 2002 ("Sarbanes-Oxley Act") Section 404(b) ("Section 404"), (2) increased disclosure obligations regarding executive compensation in our periodic reports and proxy statements, and (3) requirements of holding a nonbinding advisory vote on executive compensation and stockholder approval of any golden parachute payments not previously approved. These additional obligations will require us to dedicate internal resources, engage outside consultants, and adopt a detailed work plan to assess and document the adequacy of internal controls over financial reporting, continue steps to improve control processes, as appropriate, validate through testing that controls are functioning as documented, and implement a continuous reporting and improvement process for internal controls over financial reporting.

Our stock price is volatile and purchasers of our common stock could incur substantial losses.

Our stock price has historically fluctuated widely and is likely to continue to be volatile. From January 30, 2014, the first day of trading of our common stock, through December 31, 2019, the closing sale price of our common stock has ranged between a high of $46.00 per share and a low of $2.45 per share. The market price for our common stock may be influenced by many factors, including the other risks described in this "Risk Factors" section, and the following:

- the success or failure of competitive products or technologies;
- delays in initiating or completing and the results of preclinical studies and clinical trials of our product candidates or those of our competitors, our existing collaborators, or any future collaborators;
- regulatory or legal developments in the U.S. and other countries, especially changes in laws or regulations applicable to our product candidates;
- introductions and announcements of new products by us, our commercialization collaborators, or our competitors, and the timing of these introductions or announcements;
- actions taken by regulatory agencies with respect to our or our competitors' product candidates, products, clinical studies, manufacturing processes, or sales and marketing terms;
- actual or anticipated variations in our financial results or those of companies that are perceived to be similar to us;
- the success of our or our competitors' efforts to acquire or in-license additional technologies, products, or product candidates;
- developments concerning our or our competitors' products or collaborations, including but not limited to, those with sources of manufacturing supply and commercialization partners;
- announcements by us or our competitors of significant acquisitions, strategic collaborations, joint ventures, or capital commitments;

- our ability or inability to raise additional capital and the terms on which we raise it;
- the recruitment or departure of key personnel;
- changes in the structure of healthcare payment systems;
- market conditions in the pharmaceutical and biotechnology sectors;
- actual or anticipated changes in earnings estimates or changes in stock market analyst recommendations regarding our common stock, other comparable companies, or our industry generally;
- our failure or the failure of our competitors to meet analysts' projections or guidance that we or our competitors may give to the market;
- fluctuations in the valuation of companies perceived by investors to be comparable to us;
- announcement and expectation of additional financing efforts;
- speculation in the press or investment community;
- trading volume of our common stock;
- sales of our common stock by us or our stockholders;
- the absence of lock-up agreements with the holders of substantially all of our outstanding shares in connection with follow-on public offerings of our common stock;
- the concentrated ownership of our common stock;
- changes in accounting principles;
- terrorist acts, acts of war, or periods of widespread civil unrest;
- natural disasters and other calamities;
- general economic, industry, and market conditions; and
- developments concerning complaints or litigation against us.

In addition, the stock markets in general, and the markets for pharmaceutical, biopharmaceutical, and biotechnology stocks in particular have experienced extreme volatility that has often been unrelated to the operating performance of the issuer. These broad market and industry factors may seriously harm the market price of our common stock, regardless of our operating performance.

The future issuance of equity or of debt securities that are convertible into equity will dilute our share capital.

We may choose to raise additional capital in the future depending on market conditions, strategic considerations, and operational requirements. To the extent that additional capital is raised through the issuance of shares or other securities convertible into shares, our stockholders will be diluted. Future issuances of our common stock or other equity securities, or the perception that such sales may occur, could adversely affect the trading price of our common stock and impair our ability to raise capital through future offerings of shares or equity securities. We cannot predict the effect, if any, that future sales of common stock or the availability of common stock for future sales will have on the trading price of our common stock.

The employment agreements with our executive officers may require us to pay severance benefits to officers who are terminated in connection with a change of control of the Company, which could harm our financial condition.

Our executive officers are parties to employment agreements providing, in the event of a termination of employment in connection with a change of control of the Company, for significant cash payments for severance and other benefits and acceleration of vesting of up to all outstanding stock options. The accelerated vesting of options could result in dilution to our existing stockholders and reduce the market price of our common stock. The payment of these severance benefits could harm our financial condition. In addition, these potential severance payments may discourage or prevent third parties from seeking a business combination with us.

If securities or industry analysts do not publish research or reports about our business, or if they issue an adverse or misleading opinion regarding our stock, our stock price and trading volume could decline.

The trading market for our common stock will be influenced by the research and reports that industry or securities analysts publish about us or our business. If any of the analysts who cover us issue an adverse or misleading opinion regarding us, our business model, our intellectual property, or our stock performance, or if our target studies and operating results fail to meet the expectations of

analysts, our stock price would likely decline. If one or more of these analysts cease coverage of us or fail to publish reports on us regularly, we could lose visibility in the financial markets, which in turn could cause our stock price or trading volume to decline.

Our principal stockholders and management own a significant percentage of our stock and will be able to exert significant control over matters subject to stockholder approval.

As of December 31, 2019, our executive officers and directors, together with holders of five percent or more of our outstanding common stock and their respective affiliates, beneficially owned, in the aggregate, approximately 39.3% of our outstanding common stock, including shares subject to outstanding options and warrants that are exercisable within 60 days after such date, based on the Forms 3 and 4 and Schedules 13D and 13G filed by them with the SEC. As of December 31, 2019, our chief executive officer, Douglas M. Fambrough, III, Ph.D., beneficially owned 1,890,760, or approximately 2.6%, of our outstanding common stock including outstanding vested options; Mr. Fambrough beneficially owned 2,401,700 shares or approximately 3.4% of our outstanding common stock including outstanding vested and unvested options. As a result, these stockholders, if acting together, will continue to have significant influence over the outcome of corporate actions requiring stockholder approval, including the election of directors, any merger, consolidation, or sale of all or substantially all of our assets, and any other significant corporate transaction. The interests of these stockholders may not be the same as, or may even conflict with, the interests of our other stockholders. For example, these stockholders could delay or prevent a change of control of our Company, even if such a change of control would benefit our other stockholders, which could deprive our stockholders of an opportunity to receive a premium for their common stock as part of a sale of our Company or our assets and might affect the prevailing market price of our common stock. The significant concentration of stock ownership may adversely affect the trading price of our common stock due to investors' perception that conflicts of interest may exist or arise.

Anti-takeover provisions in our charter documents and under Delaware law could make an acquisition of us, which may be beneficial to our stockholders, more difficult and may prevent attempts by our stockholders to replace or remove our current management.

Provisions in our amended and restated certificate of incorporation and our amended and restated bylaws may delay or prevent an acquisition of us or a change in our management. In addition, these provisions may frustrate or prevent any attempts by our stockholders to replace or remove our current management by making it more difficult for stockholders to replace members of our board of directors. Because our board of directors is responsible for appointing the members of our management team, these provisions could in turn affect any attempt by our stockholders to replace current members of our management team. These provisions include:

- a prohibition on actions by our stockholders by written consent;
- a requirement that special meetings of stockholders, which the Company is not obligated to call more than once per calendar year, be called only by the chairman of our board of directors, our chief executive officer, our board of directors pursuant to a resolution adopted by a majority of the total number of authorized directors, or, subject to certain conditions, by our secretary at the request of the stockholders holding of record, in the aggregate, shares entitled to cast not less than ten percent of the votes at a meeting of the stockholders (assuming all shares entitled to vote at such meeting were present and voted);
- advance notice requirements for election to our board of directors and for proposing matters that can be acted upon at stockholder meetings; and
- the authority of the board of directors to issue preferred stock, such as the Redeemable Convertible Preferred, with such terms as the board of directors may determine.

Moreover, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporation Law, as amended, which prohibits a person who owns in excess of 15 percent of our outstanding voting stock from merging or combining with us for a period of three years after the date of the transaction in which the person acquired in excess of 15 percent of our outstanding voting stock, unless the merger or combination is approved in a prescribed manner. These provisions would apply even if the proposed merger or acquisition could be considered beneficial by some stockholders.

We incur increased costs as a result of operating as a public company, and our management is required to devote substantial time to new compliance initiatives and corporate governance practices.

As a public company, we incur, and we will continue to incur significant legal, accounting, and other expenses.

The Sarbanes-Oxley Act, the Dodd-Frank Wall Street Reform and Consumer Protection Act, the listing requirements of The Nasdaq Global Select Market, and other applicable securities rules and regulations impose various requirements on public companies, including establishment and maintenance of effective disclosure and financial controls and corporate governance practices. Our management and other personnel need to devote a substantial amount of time to these compliance initiatives. Moreover, these rules

and regulations increase our legal and financial compliance costs and make some activities more time-consuming and costly. For example, we expect that these rules and regulations make it more difficult and more expensive for us to obtain director and officer liability insurance, which in turn could make it more difficult for us to attract and retain qualified members of our board of directors. However, these rules and regulations are often subject to varying interpretations, in many cases due to their lack of specificity, and, as a result, their application in practice may evolve over time as new guidance is provided by regulatory and governing bodies. This could result in continuing uncertainty regarding compliance matters and higher costs necessitated by ongoing revisions to disclosure and governance practices.

As of December 31, 2019, we are no longer an emerging growth company and will be required to comply with the rules of the SEC that implement Section 404(b). To achieve compliance with Section 404(b) within the prescribed period, we are engaged in a process to document and evaluate our internal control over financial reporting, which is both costly and challenging. In this regard, we are dedicating internal resources, engaging outside consultants, and have adopted a detailed work plan to assess and document the adequacy of internal control over financial reporting, continue steps to improve control processes as appropriate, validate through testing that controls are functioning as documented, and implement a continuous reporting and improvement process for internal controls over financial reporting. Despite our efforts, there is a risk that we will not be able to conclude that our internal control over financial reporting is effective as required by Section 404 in one or more future periods. If we identify one or more material weaknesses, it could result in an adverse reaction in the financial markets due to a loss of confidence in the reliability of our financial statements. In addition, if we are not able to continue to meet these requirements, we may not be able to remain listed on The Nasdaq Global Select Market.

Because we do not anticipate paying any cash dividends on our capital stock in the foreseeable future, capital appreciation, if any, will be your sole source of gain.

We have never declared or paid cash dividends on our common stock. We currently intend to retain all of our future earnings, if any, to finance the growth and development of our business. As a result, capital appreciation, if any, of our common stock will be the sole source of gain of our common stockholders for the foreseeable future.

We may incur significant costs from class action litigation due to our historical or expected stock volatility.

Our stock price has fluctuated and may fluctuate for many reasons, including as a result of public announcements regarding the progress of our development efforts or the development efforts of our collaborators or competitors, the addition or departure of our key personnel, variations in our quarterly operating results, and changes in market valuations of pharmaceutical and biotechnology companies. This risk is especially relevant to us because pharmaceutical and biotechnology companies have experienced significant stock price volatility in recent years. When the market price of a stock has been volatile as our stock price has been and may be, holders of that stock have occasionally brought securities class action litigation against the company that issued the stock. If any of our stockholders were to bring a lawsuit of this type against us, even if the lawsuit is without merit, we could incur substantial costs defending the lawsuit. The lawsuit could also divert the time and attention of our management.

Our amended and restated bylaws designate the Court of Chancery of the State of Delaware as the sole and exclusive forum for certain types of actions and proceedings that may be initiated by our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us or our directors, officers, or employees.

Our amended and restated bylaws provide that, subject to limited exceptions, the Court of Chancery of the State of Delaware will be the sole and exclusive forum for any derivative action or proceeding brought on our behalf, any action asserting a claim of breach of a fiduciary duty owed by any of our directors, officers, or other employees to us or our stockholders, any action asserting a claim against us arising pursuant to any provision of the Delaware General Corporation Law, as amended, our amended and restated certificate of incorporation or our amended and restated bylaws, any action to interpret, apply, enforce, or determine the validity of our amended and restated certificate of incorporation or our amended and restated bylaws, any action to interpret, apply, enforce or determine the validity of our amended and restated certificate of incorporation or our amended and restated bylaws, or any other action asserting a claim against us that is governed by the internal affairs doctrine. Any person or entity purchasing or otherwise acquiring any interest in shares of our capital stock shall be deemed to have notice of and to have consented to the provisions of our amended and restated certificate of incorporation described above. This choice of forum provision may limit a stockholder's ability to bring a claim in a judicial forum that it finds favorable for disputes with us or our directors, officers, or other employees, which may discourage such lawsuits against us and our directors, officers, and employees. Alternatively, if a court were to find these provisions of our amended and restated certificate of incorporation inapplicable to, or unenforceable in respect of, one or more of the specified types of actions or proceedings, we may incur additional costs associated with resolving such matters in other jurisdictions, which could adversely affect our business and financial condition.

Our stockholders may experience significant dilution as a result of future equity offerings and exercise of outstanding options.

In order to raise additional capital, we may in the future offer additional shares of our common stock or other securities convertible into or exchangeable for our common stock, as we did with the Redeemable Convertible Preferred, which was converted into common stock in December 2017 and with the follow-on offerings of our common stock in December 2017 and September 2018. We cannot assure you that we will be able to sell shares or other securities in any offering at a price per share that is equal to or greater than the price paid by our existing shareholders, and investors purchasing shares or other securities in the future could have rights superior to existing stockholders. The price per share at which we sell additional shares of our common stock or other securities convertible into or exchangeable for our common stock in future transactions may be higher or lower than the price per share paid by our existing stockholders.

In addition, we have a significant number of securities allowing for the purchase of our common stock. As of February 24, 2020, we also had 7,781,915 shares of common stock reserved for future issuance under our stock incentive plans. As of that date, there were also stock options and awards to purchase 15,045,098 shares of our common stock outstanding and warrants to purchase 2,198 shares of our common stock outstanding. The exercise of outstanding options and warrants having an exercise price per share that is less than the offering price per share paid by our existing stockholders will increase dilution to such stockholders.

Future sales of our common stock in the public market could cause our stock price to fall.

Sales of a substantial number of shares of our common stock in the public market, or the perception that these sales might occur, could depress the market price of our common stock and could impair our ability to raise capital through the sale of additional equity securities. As of February 24, 2020, we had 73,750,617 shares of common stock outstanding, all of which, other than shares held by our directors and certain officers, were eligible for sale in the public market, subject in some cases to compliance with the requirements of Rule 144, including the volume limitations and manner of sale requirements. In addition, shares of common stock issuable upon exercise of outstanding options and shares reserved for future issuances under our stock incentive plans will become eligible for sale in the public market to the extent permitted by applicable vesting requirements and subject in some cases to compliance with the requirements of Rule 144.

Sales of shares issued in private placements may cause the market price of our shares to decline.

In April 2017, we issued 700,000 shares of the Redeemable Convertible Preferred in a private placement, which were convertible into shares of our common stock at an agreed conversion rate. In December 2017, all shares of Redeemable Convertible Preferred were converted into shares of our common stock. We granted the holders of Redeemable Convertible Preferred certain demand, shelf, and “piggyback” registration rights with respect to the shares of common stock issued upon conversion of the Redeemable Convertible Preferred. Such registration rights continue subsequent to the conversion and repurchase of the Redeemable Convertible Preferred with respect to the shares of common stock issued in such conversion. In accordance with such registration rights, we filed a shelf registration statement on Form S-3 covering the resale of 24,491,663 shares of our common stock by the former holders of Redeemable Convertible Preferred. The registration statement was declared effective on May 9, 2018, and all shares of common stock issued upon conversion of the Redeemable Convertible Preferred may now be freely sold in the open market. Additionally, we issued 983,208 shares of our common stock to Alnylam in April 2018, 835,834 shares of our common stock to Alexion in October 2018, 5,414,185 shares of our common stock to Lilly in December 2018, and 2,279,982 shares of our common stock to Novo in December 2019. The shares issued to Alnylam are freely tradeable in the open market, subject to certain volume limitations and compliance with applicable securities laws. The shares issued to Alexion may be freely sold in the open market subject to compliance with the requirements of Rule 144, subject to compliance with applicable securities laws. The shares issued to Novo are subject to a lock-up period but, following the expiration of such lock-up periods, such shares of our common stock may be freely sold in the open market subject to compliance with the requirements of Rule 144, subject to compliance with applicable securities laws. The sale of a significant amount of these shares in the open market or the perception that these sales may occur could cause the market price of our common stock to decline or become highly volatile.

ITEM 1B. UNRESOLVED STAFF COMMENTS

None.

ITEM 2. PROPERTIES

On January 2, 2019, we entered into a seven-year lease for 80,872 square feet of office and laboratory space located in Lexington, Massachusetts. This location became the Company’s corporate headquarters during November 2019.

On January 14, 2020, we entered into a real property lease agreement with a 125-month term for 61,282 square feet of office space in Lexington, Massachusetts. The term of the lease has not yet commenced.

Our former headquarters in Cambridge, Massachusetts, where we lease 37,084 square feet of office and laboratory space, continues to support the business. The lease term for our office and laboratory space in Cambridge, Massachusetts, commenced in December 2014 for six years.

On August 26, 2019, we entered into an 87-month term lease agreement for 15,781 square feet of office space in Boulder, Colorado. We intend to relocate our currently remote Colorado employees to this facility upon lease commencement, which we currently anticipate will occur in the second quarter of 2020.

We believe that suitable additional or alternative space will be available as needed on commercially reasonable terms.

ITEM 3. LEGAL PROCEEDINGS

From time to time we may be subject to legal proceedings, claims, and litigation arising in the ordinary course of business. We are not currently a party to or aware of any proceedings that we believe will have, individually or in the aggregate, a material adverse effect on our business, financial condition, or results of operations. Any future litigation could result in substantial costs and divert our management's attention and resources, which could cause serious harm to our business, operating results, and financial condition. We maintain liability insurance; however, if any costs or expenses associated with this or any other litigation exceed our insurance coverage, we may be forced to bear some or all of these costs or expenses directly, which could be substantial.

ITEM 4. MINE SAFETY DISCLOSURES

Not applicable.

PART II

ITEM 5. MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES

Market Information for Common Stock

Our common stock trades on The Nasdaq Global Select Market under the symbol "DRNA."

Equity Compensation Plans

For information regarding equity compensation plans, see Item 12 of this Annual Report on Form 10-K.

Holders of Record

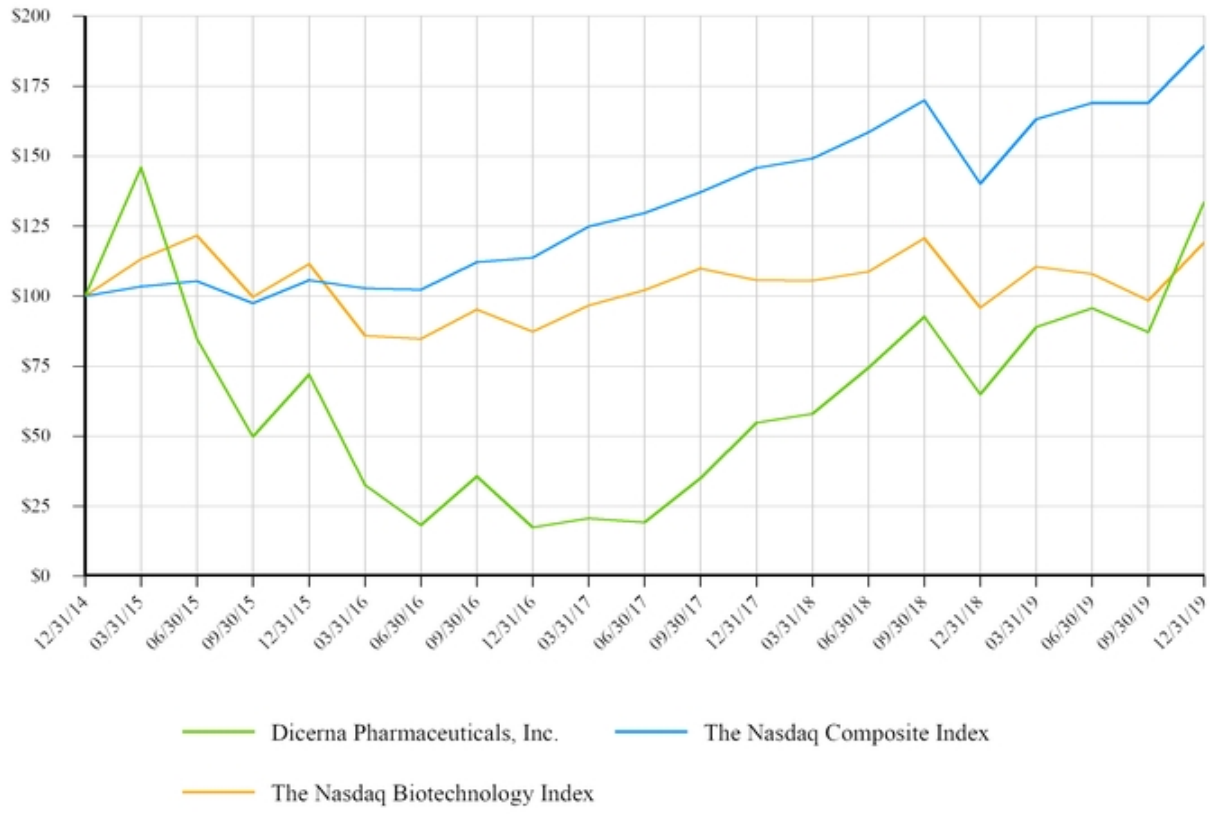
As of February 24, 2020, there were approximately eight holders of record of our common stock. Because many of our shares of common stock are held by brokers and other institutions on behalf of stockholders, we are unable to estimate the total number of beneficial stockholders represented by these record holders.

Dividend Policy

We currently intend to retain future earnings, if any, for use in the operation of our business and to fund future growth. We have never declared or paid cash dividends on our common stock and we do not intend to pay any cash dividends on our common stock for the foreseeable future. Any future determination related to our dividend policy will be made at the discretion of our board of directors in light of conditions then existing, including factors such as our results of operations, financial condition and requirements, business conditions, and covenants under any applicable contractual arrangements.

Performance Graph

The following graph illustrates a comparison of the total cumulative stockholder return on our common stock to The Nasdaq Composite and The Nasdaq Biotechnology indices for each of the last five fiscal years ended December 31, 2019, assuming an initial investment of $100 on December 31, 2014. The stock price performance on the following graph is not necessarily indicative of future stock price performance. This performance graph shall not be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, or incorporated by reference into any of our filings under the Securities Act or the Exchange Act, except as shall be expressly set forth by specific reference in such filing.



Recent Sales of Unregistered Securities

On December 27, 2019, the Company issued 2,279,982 shares (the "Novo Shares") of the Company's common stock, par value $0.0001 per share, to Novo Nordisk A/S ("Novo"), at a purchase price of $21.93 per share, for an aggregate purchase price of approximately $50.0 million. The Novo Shares were offered and issued in a private placement exempt from registration pursuant to Section 4(a)(2) of the Securities Act of 1933, as amended, or Regulation D promulgated thereunder, as a transaction by an issuer not involving a public offering.

Use of Proceeds from Initial Public Offering of Common Stock

Not applicable.

Purchases of Equity Securities by the Issuer and Affiliated Parties

None.

ITEM 6. SELECTED FINANCIAL DATA

The following selected consolidated financial data has been derived from our audited consolidated financial statements as of December 31, 2019 and 2018 and for the fiscal years ended December 31, 2019, 2018, and 2017, and are included elsewhere in this Annual Report on Form 10-K. The information set forth below should be read in conjunction with "Management's Discussion and Analysis of Financial Condition and Results of Operations," included in Item 7 of this Annual Report on Form 10-K, and with our consolidated financial statements and notes thereto, included in Item 8 of this Annual Report on Form 10-K. The information set forth below is not necessarily indicative of our future results of operations or financial condition.

	YEAR ENDED DECEMBER 31,				
(in thousands, except share and per share data)	2019	2018	2017 [a]	2016	2015
Results of operations data					
Revenue [b]	$ 23,904	$ 6,176	$ 1,030	$ —	$ —
Net loss	$ (120,459)	$ (88,853)	$ (60,200)	$ (59,513)	$ (62,839)
Net loss attributable to common stockholders	$ (120,459)	$ (88,853)	$ (80,292)	$ (59,513)	$ (62,839)
Net loss per share attributable to common stockholders – basic and diluted	$ (1.76)	$ (1.60)	$ (3.66)	$ (2.87)	$ (3.09)
Weighted average common shares outstanding – basic and diluted	68,428,046	55,616,092	21,917,415	20,719,761	20,320,628

[a] Reflects the retrospective adoption of the new revenue recognition accounting standard, which the Company adopted on January 1, 2018. Refer to Note 2 to our consolidated financial statements (see Item 8 of this Annual Report on Form 10-K) for more information.

[b] In 2018, we reclassified income from government grants of $1.1 million, $0.3 million, and $0.2 million as offsets to research and development expenses for the years ended December 31, 2017, 2016, and 2015, respectively, to conform to the presentation in 2018.

	DECEMBER 31,				
(in thousands)	2019	2018	2017 [a]	2016	2015
Financial condition data					
Cash and cash equivalents	$ 152,816	$ 54,239	$ 68,789	$ 20,865	$ 56,058
Held-to-maturity investments	$ 196,065	$ 248,387	$ 44,889	$ 25,009	$ 38,551
Total assets	$ 597,409	$ 409,041	$ 121,002	$ 51,252	$ 100,023
Total noncurrent liabilities	$ 203,479	$ 114,293	$ 3,090	$ —	$ —
Total stockholders' equity	$ 152,195	$ 200,693	$ 101,086	$ 41,208	$ 91,022

[a] Reflects the retrospective adoption of the new revenue recognition accounting standard, which the Company adopted on January 1, 2018. Refer to Note 2 to our consolidated financial statements (see Item 8 of this Annual Report on Form 10-K) for more information.

ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

The following discussion contains forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from those discussed here. Factors that could cause or contribute to such differences include, but are not limited to, those discussed in this section as well as factors described in Part I, Item 1A – "Risk Factors" and "Special Note Regarding Forward-Looking Statements" included elsewhere in this Annual Report on Form 10-K.

Overview

Dicerna™ Pharmaceuticals, Inc. ("we", "us," "our," "the Company," or "Dicerna") is a biopharmaceutical company using ribonucleic acid ("RNA") interference ("RNAi") to develop medicines that silence genes that cause or contribute to disease. The Company's proprietary GalXC™ technology is being applied to develop what we believe will be potent, selective, and safe RNAi therapies to treat diseases involving the liver, including rare diseases, chronic liver diseases, cardiometabolic diseases, and viral infectious diseases. As we further enhance our GalXC technology, we aim to extend our focus beyond the liver to include central nervous system ("CNS") diseases and diseases involving other bodily tissues. Dicerna aims to treat a broad range of diseases by addressing the underlying causes of illness, focusing on target genes where connections between gene and disease are well understood and documented. Dicerna intends to discover, develop, and commercialize novel therapeutics either on its own or in collaboration with pharmaceutical partners. Dicerna has strategic collaborations with Novo Nordisk A/S ("Novo"), F. Hoffmann-La Roche Ltd and Hoffmann-La Roche Inc. (together, "Roche"), Eli Lilly and Company ("Lilly"), Alexion Pharmaceuticals, Inc. (together with its affiliates, "Alexion"), and Boehringer Ingelheim International GmbH ("BI").

All of our GalXC drug discovery and development efforts are based on the therapeutic modality of RNAi, a highly potent and specific mechanism for silencing the activity of a targeted gene. In this naturally occurring biological process, double-stranded RNA molecules induce the enzymatic destruction of the messenger ribonucleic acid ("mRNA") of a target gene that contains sequences that are complementary to one strand of the therapeutic double-stranded RNA molecule. Our approach is to design proprietary double-stranded RNA molecules that have the potential to engage the enzyme Dicer and initiate an RNAi process to silence a specific target gene. Our GalXC RNAi platform utilizes a proprietary structure of double-stranded RNA molecules. For our current clinical programs, our GalXC RNAi platform has been configured for subcutaneous delivery to the liver. Due to the enzymatic nature of RNAi, a single GalXC molecule incorporated into the RNAi machinery can destroy hundreds or thousands of mRNAs from the targeted gene.

The GalXC RNAi platform supports Dicerna's long-term strategy to retain a full or substantial ownership stake in our programs, subject to the evaluation of potential licensing opportunities as they may arise, and to invest internally in programs for diseases with focused patient populations, such as certain rare diseases. These certain rare disease programs, which include our nedosiran (formerly DCR-PHXC) and DCR-A1AT programs, represent opportunities that we believe carry a relatively higher probability of success, with genetically and molecularly defined disease markers, high unmet medical need, a limited number of centers of excellence to facilitate reaching these patients, and the potential for more rapid clinical development paths to regulatory approval. For more complex diseases with multiple gene dysfunctions and/or larger patient populations, we plan to pursue collaborations that can provide the enhanced scale, resources, and commercial infrastructure required to maximize these prospects.

We currently view our operations and manage our business as one segment which encompasses the discovery, research, and development of treatments based on our RNAi technology platform.

Executive Summary

Our results of operations for the year ended December 31, 2019, compared to the prior year, reflect the following:

- On January 1, 2019, we implemented the new lease accounting standard issued by the Financial Accounting Standards Board, *Leases* (Topic 842). Upon adoption, we recorded a right-of-use asset of $2.7 million which is recorded in noncurrent assets in the consolidated balance sheets, a short-term lease liability of $1.4 million, and a long-term lease liability of $1.4 million. As of December 31, 2019, the right-of-use asset was $30.1 million, and the short-term and long-term lease liabilities were $3.4 million and $20.1 million, respectively.
- On January 2, 2019, we entered into a seven-year non-cancelable real property lease agreement for 80,872 square feet of laboratory and office space in Lexington, Massachusetts. This location became our corporate headquarters and research facility during the fourth quarter of 2019.
- On January 4, 2019, we entered into a non-cancelable real property sublease agreement for 9,653 square feet of office space in Cambridge, Massachusetts. The term of the sublease commenced on January 11, 2019 and extends through the sublease expiration date of July 30, 2021.

- On August 26, 2019, we entered into an 87-month non-cancelable real property lease agreement for 15,781 square feet of office space in Boulder, Colorado. On February 4, 2020, we amended this lease to allow for the rental of an additional 6,985 square feet of office space. We intend to relocate our currently remote Colorado employees to a portion of this facility upon lease commencement, which we anticipate will occur in the first quarter of 2020, and plan to occupy the remainder of the space commencing in the second quarter of 2020.
- On October 30, 2019, we entered into the Roche Collaboration Agreement. Under the terms of the Roche Collaboration Agreement, we and Roche will seek to progress RG6346, our investigational therapy in Phase 1 clinical development, toward worldwide development and commercialization as well as an option for the companies to collaborate in the discovery, development, and commercialization of oligonucleotide therapeutics intended for the treatment of HBV. We were entitled to an upfront payment of $200.0 million. We are also eligible to receive additional payments totaling up to approximately $1.47 billion, which includes payments upon achievement of specified development, regulatory, and commercial milestones for RG6346. In addition, the Roche Collaboration Agreement provides that Roche will pay us up to mid-teens percent royalties on product sales. We also have an option to co-fund the development of products under the agreement and, if exercised, receive high twenties to mid-thirties royalty rates on the net sales of products in the U.S. If we exercise the co-funding option, we also have an option to co-promote products containing RG6346 in the U.S.
- On November 15, 2019, we entered into the Novo Collaboration Agreement. Under the terms of the Novo Collaboration Agreement, we and Novo will seek to use our proprietary GalXC™ RNAi platform technology to progress novel therapies for the treatment of liver-related cardiometabolic diseases towards clinical development and commercialization. We were entitled to an upfront payment of $175.0 million. In connection with the Novo Collaboration Agreement, Novo made a $50.0 million equity investment in Dicerna at a premium pursuant to the Novo Share Issuance Agreement, which we received in December 2019. We are also eligible to receive an additional $75.0 million ($25.0 million at the end of each of the first three years of the Novo Collaboration Agreement), contingent upon the Company delivering GalXC™ molecules for a defined number of targets, and additional payments totaling up to approximately $357.5 million per target upon achievement of specified development, regulatory, and commercial milestones. In addition, the Novo Collaboration Agreement provides that Novo will pay us up to mid-single-digits to mid-teens royalties on product sales on a country-by-country and product-by-product basis until the later of 10 years after the date of first commercial sale of each product in such country, expiration of specified patent rights in such country, or the expiration of specified regulatory exclusivity in such country for GalXC products, subject to royalty step-down provisions set forth in the agreement.
- In November 2019, we entered into an initial five-year agreement with a supplier for the development, manufacture, and supply of clinical and commercial product. In January 2020, we executed an amendment to this agreement which allows for advance preferential scheduling to the manufacturing line.
- In December 2019, Alexion exercised its option for the exclusive rights to two additional targets within the complement pathway for the discovery and development of GalXC™ RNAi molecules. This exercise expands Dicerna and Alexion's existing research collaboration and license agreement to now encompass four targets within the complement pathway. In connection with the option exercise, Alexion paid Dicerna a total of $20.0 million, or $10.0 million in option exercise fees per additional target during December 2019 that will be recognized into revenue as the related services are performed.
- On January 14, 2020, we entered into a non-cancelable 10-year real property lease agreement for 61,282 square feet of office space in Lexington, Massachusetts. The term of the lease has not yet commenced.
- Revenue during the year ended December 31, 2019 reflects $13.1 million, $4.4 million, and $6.3 million from the Lilly, Alexion, and BI collaborations, respectively, compared to $0.1 million and $6.1 million from the Alexion and BI collaborations, respectively, during the prior year.

Development Programs

In choosing which development programs to internally advance, we apply the scientific, clinical, and commercial criteria that we believe allow us to best leverage our GalXC RNAi platform and maximize value. Using our GalXC RNAi technology, and applying the criteria of our development focus, we have created a pipeline of core therapeutic programs for development by Dicerna. For opportunities that were not selected as a core program opportunity, we have sought partners to fund the discovery, and subsequently drive the development of, these non-core opportunities in exchange for upfront payments, milestone payments, royalties on product sales, and potentially other economic and operational arrangements. Our current collaborations with Novo, Lilly, Alexion, and BI resulted from this effort. For core programs targeting rare diseases, we intend to develop these programs internally through approval. For core programs targeting larger populations, we may seek development partners, such as our collaboration with Roche on RG6346, under various economic and operational arrangements. Together, our core program pipeline and our pipeline of non-core collaborative programs constitute a broad and growing therapeutic pipeline that we believe may result in multiple valuable approved products based on our GalXC technology.

In addition to the programs listed in our pipeline, we are exploring a variety of potential programs involving gene targets in the liver, CNS, and other tissues, which we may elevate in the future to be either a core program or a non-core collaborative program. Under our collaborations with Novo, Roche, and Lilly, our collaborators have rights to nominate additional programs for discovery by Dicerna and subsequent development by the nominating collaborator, and which will become part of our non-core pipeline.

Our four core programs are: nedosiran for the treatment of primary hyperoxaluria ("PH"), RG6346 (formerly DCR-HBVS) for the treatment of chronic hepatitis B virus ("HBV") infection, DCR-A1AT for the treatment of alpha-1 antitrypsin ("A1AT") deficiency-associated liver disease, and a program for the treatment of a common disease involving the liver.

The table below sets forth the state of development of our various GalXC RNAi platform product candidates as of February 27, 2020.

CANDIDATE	INDICATION	RESEARCH	PRECLINICAL	CLINICAL POC TRIALS	REGISTRATION TRIALS	PARTNER
Nedosiran (DCR-PHXC)	Primary Hyperoxaluria					—
RG6346 (DCR-HBVS)	Hepatitis B Virus					Roche
DCR-A1AT	A1AT Liver Disease					—
DCR-undisclosed	Undisclosed					—
DCR-LIV2	NASH					Boehringer Ingelheim
LY3561774*	Cardiometabolic					Lilly
DCR-CM2	Cardiometabolic					Lilly
DCR-CM4	Cardiometabolic					Lilly
DCR-CM5	Cardiometabolic/non-liver					Lilly
DCR-NEURO1	Neurodegeneration					Lilly
DCR-NEURO2	Neurodegeneration					Lilly
DCR-LLY9	Undisclosed					Lilly
DCR-PAIN1	Pain					Lilly
DCR-PAIN2	Pain					Lilly
DCR-COMP1	Complement-mediated					Alexion
DCR-COMP2	Complement-mediated					Alexion
DCR-COMP3	Complement-mediated					Alexion
DCR-COMP4	Complement-mediated					Alexion

** Formerly DCR-CM1*

ORPHAN PREVALENT

Status of Dicerna Programs

Our current GalXC RNAi platform development programs are as follows:

Nedosiran for Primary Hyperoxaluria

We are developing our lead GalXC product candidate, nedosiran, for the treatment of primary hyperoxaluria ("PH") type 1 ("PH1"), PH type 2 ("PH2"), and PH type 3 ("PH3"), which is in the pivotal phase of clinical development. PH is a family of severe, ultra-rare, genetic liver disorders characterized by the overproduction of oxalate, a highly insoluble metabolic end-product that is eliminated from the body mainly by the kidneys. In patients with PH, the kidneys are unable to eliminate fully the large amount of oxalate that is produced. The accumulation of oxalate compromises the renal system, which may result in severe damage to the kidneys and other organs.

PH encompasses three genetically distinct, autosomal-recessive, inborn errors of glyoxylate metabolism characterized by the over-production of oxalate. PH1, PH2, and PH3 are each characterized by a specific enzyme deficiency. PH1 is caused by a deficiency of glyoxylate-aminotransferase, PH2 is caused by a deficiency of glyoxylate reductase/hydroxypyruvate reductase, and PH3 is caused by a deficiency of 4-hydroxy-2-oxoglutarate aldolase. Patients with PH are predisposed to the development of recurrent urinary tract (urolithiasis) and kidney (nephrolithiasis) stones, composed of calcium oxalate crystals. Stone formation is accompanied by nephrocalcinosis in some patients with PH1 and PH2. This deposition of calcium oxalate crystals in the renal parenchyma produces tubular toxicity and renal damage that is compounded by the effects of renal calculi-related obstruction and frequent superimposed infections. Based on evaluation of genome sequence databases, there may be as many as 16,000 people with PH in the U.S. and major European countries.

As of November 2019, we completed all study participant dosing and follow-up in PHYOX™1, a Phase 1 single-ascending-dose study of nedosiran in healthy volunteers and study participants with PH type 1 (“PH1”) and PH type 2 (“PH2”). The primary objective of the study was to evaluate the safety, tolerability, pharmacokinetics, and pharmacodynamics of single-ascending doses of nedosiran. Secondary endpoints included the change in 24-hour urinary oxalate excretion from baseline, defined as the mean of two 24-hour collections during screening. The trial was divided into two groups:

- Group A was a placebo-controlled, single-blind study and included 25 healthy volunteers at a single site in the United Kingdom with five cohorts dosed at 0.3, 1.5, 3.0, 6.0, or 12.0 mg/kg of nedosiran or placebo (3:2 randomization).
- Group B was an open-label study and included 18 participants, 15 with PH1 and three with PH2, and included three cohorts of participants dosed at 1.5, 3.0, and 6.0 mg/kg of nedosiran and a fourth cohort with mixed dosing. Group B participants were enrolled among three sites in the European Union, one in the United Kingdom, and one site in the United States.

RG6346 for Chronic Hepatitis B Virus Infection

Our GalXC RNAi platform-based product candidate for the treatment of chronic HBV infection, RG6346 (formerly DCR-HBVS), is currently being tested in a Phase 1 clinical trial. HBV is reported to be the most common serious liver infection affecting an estimated 292 million people globally. Chronic HBV infection is characterized by the presence of the HBV surface antigen (“HBsAg”) for six months or more.

The DCR-HBVS-101 clinical trial is a Phase 1, randomized, placebo-controlled, double-blind study designed to evaluate the safety and tolerability of RG6346 in healthy volunteers and in patients with non-cirrhotic chronic HBV. Secondary objectives are to characterize the pharmacokinetic profile of RG6346 and to evaluate preliminary antiviral efficacy, as well as characterize the pharmacodynamics of HBsAg and HBV DNA levels in blood. The DCR-HBVS-101 clinical trial is divided into three phases or groups:

- Group A is a single-ascending-dose arm in which 30 healthy volunteers received a dose of RG6346 (0.1, 1.5, 3.0, 6.0, or 12.0 mg/kg) or placebo, with a four-week follow-up period. Group A dosing was completed in August 2019.
- Group B is a single-dose arm in which eight participants with chronic HBV who are naïve to nucleoside analog therapy will receive a 3.0 mg/kg dose of RG6346 or placebo; these participants will be followed for at least 12 weeks. We initiated Group B dosing in the third quarter of 2019, in parallel with Group C at the 3.0 mg/kg dose level. Group B dosing is expected to be completed in the first quarter of 2020.
- Group C is a multiple-ascending-dose arm in which RG6346 (1.5, 3.0, or 6.0 mg/kg) or placebo will be administered to 18 participants with chronic HBV who are already being treated with nucleoside analogs, with a treatment and follow-up period of 16 weeks or more.
    - We dosed the first patient, from Group C, at a dose of 1.5 mg/kg, in May 2019. The final patient’s last dose in the 1.5 mg/kg dose cohort was administered in October 2019.
    - We dosed the first patient in 3.0 mg/kg cohort in August 2019. The final patient’s last dose in the 3.0 mg/kg dose group was administered in January 2020.
    - We dosed the first patient in the 6.0 mg/kg cohort in December 2019 and are enrolling the remainder of the cohort.

In order to be optimally positioned to develop and commercialize our product candidate, RG6346, in combination with other novel drugs, we entered into a research collaboration and licensing agreement with Roche in October 2019. Under the terms of the agreement, we will be leading the development of RG6346 through the current Phase 1 trial, and pending favorable results, Roche intends to further develop RG6346 with the overall goal of developing a combination regime to achieve a long-term immunological cure of chronic HBV in combination with additional Roche product candidates in Phase 2 and Phase 3 clinical trials.*DCR-A1AT for*

Alpha-1 Antitrypsin Deficiency-Associated Liver Disease

Our GalXC RNAi platform-based product candidate for the treatment of alpha-1 antitrypsin ("A1AT") deficiency-associated liver disease, DCR-A1AT, is currently being tested in a Phase 1/2 clinical study. A1AT deficiency is an inherited disorder that can lead to liver disease in children and adults and lung disease in adults. The disorder is caused by mutations in a gene called *SERPINA1*. This gene, when functioning normally, provides instructions for making the A1AT protein, which protects the body from an enzyme called neutrophil elastase. This enzyme is released from white blood cells to fight infection, but it can attack normal tissues if not tightly controlled by A1AT. Mutations in the *SERPINA1* gene can result in a deficiency of A1AT or, most commonly, an abnormal form of the protein that cannot control neutrophil elastase. Accumulation of abnormal A1AT protein in the liver can lead to liver disease. Uncontrolled neutrophil elastase can also destroy alveoli (small air sacs in the lungs) and cause lung disease.

A1AT deficiency occurs all over the world, though its prevalence varies by population. The disorder affects roughly one in 1,500 to 3,500 individuals with European ancestry but is uncommon in people of Asian descent. Congenital A1AT deficiency is estimated to affect 2.4 people out of every 10,000 in the EU.

The initial DCR-A1AT-101 clinical trial is a Phase 1/2 randomized, placebo-controlled study designed to evaluate the safety and tolerability of DCR-A1AT in healthy volunteers and in patients with A1AT deficiency-associated liver disease. Secondary objectives are to characterize the pharmacokinetic profile of DCR-A1AT, to evaluate preliminary pharmacodynamics on serum A1AT protein concentrations, and to characterize the effect of DCR-A1AT on A1AT deficiency-associated liver disease evaluated by liver biopsy. Exploratory objectives include characterization of the effect of DCR-A1AT on A1AT deficiency-associated liver disease evaluated by biochemical markers as well as the effect on liver stiffness. The DCR-A1AT-101 clinical trial is divided into two phases or groups:

- Group A is a single-ascending-dose arm in which a single dose of DCR-A1AT (0.1, 1.0, 3.0, 6.0, or 12.0 mg/kg) or placebo will be administered to up to 36 healthy volunteers, with a minimum 8-week follow-up. The first participant in Group A was dosed in November 2019; we expect dosing of Group A to be completed in the second half of 2020.

- Group B is a multiple-ascending-dose arm in which DCR-A1AT (doses yet to be determined) or placebo will be administered to up to 24 participants with A1AT with a treatment and follow-up period of 12 weeks or more.

DCR-Undisclosed

We are currently pursuing preclinical development of an undisclosed candidate for the treatment of a common disease involving the liver. We expect to begin a Phase 1 study for this program in 2021.

Critical Accounting Policies and Significant Judgments and Estimates

Our discussion and analysis of our financial condition and results of operations is based on our consolidated financial statements, which have been prepared in accordance with accounting principles generally accepted in the U.S. The preparation of our consolidated financial statements requires us to make estimates and apply judgments that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the consolidated financial statements, as well as the revenue and expenses incurred during the reported periods. We base our estimates on historical experience and on various other factors that we believe are reasonable under the circumstances. Actual results may differ from these estimates and could have a material impact on our consolidated financial statements.

While our significant accounting policies are more fully described in the notes to our consolidated financial statements included elsewhere in this Annual Report on Form 10-K, we believe the following accounting policies are the most critical to understanding the judgments and estimates applied in our reported financial results.

Revenue recognition

We generate revenue from research collaboration and license agreements with third-party customers. Goods and services in the agreements typically include (i) the grant of licenses for the use of our technology and (ii) the provision of services associated with the research and development of customer product candidates. Such agreements may provide for consideration to us in the form of upfront payments, research and development services, option payments, milestone payments, and royalty payments on licensed products.

We account for a contract when we have approval and commitment from both parties, when the rights of the parties are identified, when payment terms are identified, when the contract has commercial substance, and when collectability of consideration is probable.

In determining the appropriate amount of revenue to be recognized as we fulfill our obligations under each of our agreements, management completes the following steps: (i) identifies the contract(s) with a customer; (ii) identifies the performance obligations in the contract; (iii) measures the transaction price, including whether there are any constraints on variable consideration; (iv) allocates the transaction price to the performance obligations; and (v) recognizes revenue when (or as) we satisfy each performance obligation.

In order to account for our contracts with customers, we identify the promised goods or services in the contract and evaluate whether such promised goods or services represent performance obligations. We account for those components as separate performance obligations when the following criteria are met:

- the customer can benefit from the good or service either on its own or together with other resources that are readily available to the customer, and
- our promise to transfer the good or service to the customer is separately identifiable from other promises in the contract.

This evaluation requires subjective determinations and requires us to make judgments about the promised goods and services and whether such goods and services are separable from the other aspects of the contractual relationship. In determining the performance obligations, we evaluate certain criteria, including whether the promised good or service is capable of being distinct and whether such good or service is distinct within the context of the contract, based on consideration of the relevant facts and circumstances for each arrangement. Factors considered in this determination include the research, manufacturing, and commercialization capabilities of the partner; the availability of research and manufacturing expertise in the general marketplace; and the level of integration, interrelation, and interdependence among the promises to transfer goods or services.

At contract inception, we determine the standalone selling price for each performance obligation identified in the contract. If an observable price of the promised good or service sold separately is not readily available, we utilize assumptions that require judgment to determine the standalone selling price for each performance obligation identified in the underlying contract, which may include development timelines, probabilities of technical and regulatory success, reimbursement rates for personnel costs, forecasted revenues, potential limitations to the selling price of the product, expected technological life of the product, and discount rates. The transaction price is allocated among the performance obligations using the relative selling price method, and the applicable revenue recognition criteria are applied to each of the separate performance obligations.

Licenses of intellectual property: If a license granted to a customer to use our intellectual property is determined to be distinct from the other performance obligations identified in the arrangement, we recognize revenue from consideration allocated to the license when the license is transferred to the licensee and the licensee is able to use and benefit from the license. For licenses that are bundled with other promises, we apply judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, to conclude upon the appropriate method of measuring progress for purposes of recognizing revenue related to consideration allocated to the performance obligation. We evaluate the measure of progress each reporting period and, if necessary, adjust the measure of performance and related revenue recognition.

Milestone payments: At the inception of each contract with a customer that includes development or regulatory milestone payments, we evaluate whether the milestones are considered probable of being reached and estimate the amount to be included in the transaction price using the most likely amount method. If it is probable that a significant revenue reversal would not occur, the associated milestone value is included in the transaction price. Milestone payments that are not within our control or of the licensee, such as regulatory approvals, are assessed as to the probability of achieving the related milestones. At the end of each subsequent reporting period, we re-evaluate the probability of achievement of all milestones and any related constraint, and, if necessary, adjust the estimate of the overall transaction price. Any such adjustments are recorded on a cumulative catch-up basis and are recorded as revenue and through earnings in the period of adjustment.

Options: Customer options, such as options granted to allow a licensee to choose to research and develop additional product candidates or reserve product candidates against target genes to be identified in the future, or options that allow a customer to designate a target as a lead product, are evaluated at contract inception in order to determine whether those options provide a material right (i.e., an optional good or service offered for free or at a discount) to the customer. If the customer option represents a material right, the material right is treated as a separate performance obligation at the outset of the arrangement. The Company allocates the transaction price to material rights based on the standalone selling price, and revenue is recognized when or as the future goods or services are transferred or when the option expires. Customer options that are not material rights do not give rise to separate performance obligations, and as such, the additional consideration that would result from a customer exercising an option in the future is not included in the transaction price for the current contract. Instead, the option is deemed a marketing offer, and additional option fee payments are recognized or begin being recognized as revenue when the licensee exercises the options. The exercise of an option that does not represent a material right is treated as a separate contract for accounting purposes.

Research and development services: Arrangements that include a promise to provide research or development services at the licensee's discretion are assessed to determine whether the services provide a material right to the licensee and are capable of being distinct, are not highly interdependent or do not significantly modify one another, and if so, the services are accounted for as separate performance obligations as the services are provided to the customer. Otherwise, when research or development services are determined not to be capable of being distinct or distinct within the context of the contract, those services are combined with the performance obligation that includes the underlying license.

Royalties: For arrangements that include sales-based royalties, including commercial milestone payments based on the achievement of a specified level of sales, and when the license is deemed to be the predominant item to which the royalties relate, we recognize revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied (or partially satisfied). To date, we have not recognized any royalty revenue resulting from any out-licensing arrangement.

We receive payments from our licensees as established in each contract. Upfront payments and fees are recorded as deferred revenue upon receipt or when due and may require deferral of revenue recognition to a future period until (or as) we satisfy our performance obligations under these arrangements. Where applicable, amounts are recorded as contracts receivable when our right to consideration is unconditional. We do not assess whether a contract with a customer has a significant financing component if the expectation at contract inception is such that the period between payment by the licensees and the transfer of the promised goods or services to the licensees will be one year or less.

Stock-based compensation

Our stock-based compensation programs grant awards which may include stock options, restricted common stock, rights to acquire stock, and other stock-based awards. Stock-based compensation cost is measured at the grant date based on the fair value of the award and is recognized as expense over the requisite service period, which generally represents the vesting period, and includes an estimate of the awards that will be forfeited.

We estimate the fair values of stock options granted to our employees and non-employees on the grant date, rights to acquire stock granted under our Employee Stock Purchase Plan, and the resulting stock-based compensation expense, using the Black-Scholes option-pricing model. The Black-Scholes option-pricing model requires the use of judgment to develop input assumptions, some of which are highly subjective, including: (i) the fair value of our common stock on the date of grant; (ii) the expected volatility of our stock; (iii) the expected term of the award; (iv) the risk-free interest rate; and (v) expected dividends. In applying these assumptions, we consider the following factors:

Fair Value of Common Stock: We use the market closing price for our common stock on the date of grant to determine the fair value of our common stock on the date of grant.

Expected Term: The expected term assumption represents the weighted average period the stock options are expected to be outstanding. We use the simplified method to calculate the expected term for options granted to employees as our stock option grants are considered "plain vanilla" and we do not have sufficient historical exercise data to provide a reasonable basis upon which to estimate the expected term due to the limited period of time our common stock has been publicly traded. The simplified method calculates the expected term as the average time-to-vesting and the contractual life of the options. We plan to continue to use the simplified method until we have sufficient exercise history as a publicly-traded company.

Expected Volatility: Due to the lack of company-specific historical and implied volatility data, we base our estimate of expected volatility on the historical volatility of a group of similar companies that are publicly traded. The historical volatility is calculated based on a period of time commensurate with the expected term assumption. The computation of expected volatility is based on the historical volatility using the daily closing prices of a representative group of companies with similar characteristics to us, including stage of life cycle, financial leverage, enterprise value, risk profiles, and position within the industry, along with historical share price information sufficient to meet the expected life of the stock-based awards. We believe the group selected has sufficient similar economic and industry characteristics and includes companies that are most representative of our company. We intend to continue to consistently apply this process using the same or similar public companies until a sufficient amount of historical information regarding the volatility of our own common stock share price becomes available, or unless circumstances change such that the identified companies are no longer similar to us, in which case, more suitable companies whose share prices are publicly available would be utilized in the calculation.

Risk-Free Interest Rate: The risk-free interest rate is based on the implied yield available on U.S. Treasury zero-coupon issues in effect at the time of grant for periods corresponding with the expected term of the option.

Expected Dividend Yield: We have never paid and have no plans to pay dividends on our common stock. Therefore, we use an expected dividend yield of zero.

Stock-based compensation expense recognized in the financial statements is based on awards that are ultimately expected to vest. Accordingly, we are also required to estimate forfeitures at the time of grant, and to revise those estimates in subsequent periods if actual forfeitures differ from estimates. We use historical data to estimate pre-vesting option forfeitures and record stock-based compensation expense only for those awards that are expected to vest. Our forfeiture rate estimates are based on an analysis of our actual forfeiture experience, employee turnover behavior, and other factors. The impact of any adjustments to our forfeiture rates would be recorded as a cumulative adjustment in the period of adjustment. To the extent that actual forfeitures differ from our estimates, the difference is recorded as a cumulative adjustment in the period the estimates were revised.

Recent Accounting Pronouncements

A summary of recent accounting pronouncements that we have adopted or expect to adopt is included in Note 2 – Summary of Significant Accounting Policies to our consolidated financial statements (see Part I, Item 8 – "Financial Statements and Supplementary Data" of this Annual Report on Form 10-K). Additional information regarding relevant accounting pronouncements is provided below.

Adopted in 2019

Leases

In February 2016, the FASB issued ASU No. 2016-02, *Leases* (Topic 842), as amended by multiple standards updates, in order to increase transparency and comparability among organizations by requiring lessees to recognize most leases on their balance sheets and making targeted changes to lessor accounting. The most significant change arising from the new standard is the recognition of right-of-use ("ROU") assets and lease liabilities for leases classified as operating leases. Under the standard, disclosures are required to enable financial statement users to assess the amount, timing, and uncertainty of cash flows arising from the leases. Companies are also required to recognize and measure leases existing at, or entered into after, the adoption date using a modified retrospective approach, with certain practical expedients available. Comparative periods prior to adoption have not been retrospectively adjusted.

We adopted the standard on January 1, 2019 and elected the package of three practical expedients that permitted an entity not to (a) reassess whether expired or existing contracts contain leases, (b) reassess lease classification for existing or expired leases, and (c) consider whether previously capitalized initial direct costs would be appropriate under the new standard.

Upon adoption, we recorded ROU assets of $2.7 million and lease liabilities of $2.8 million. Initial implementation of the standard did not have a material impact on the statement of operations or statement of cash flows.

Adopted in 2018

Revenue recognition

In May 2014, the accounting guidance related to revenue recognition was amended to provide a single, comprehensive standard for accounting for revenue from contracts with customers. The new guidance became effective for us on January 1, 2018 and applies to all contracts with customers. Under the new guidance, revenue is recognized for contracts with customers based on a model that includes identifying performance obligations and determining and allocating the transaction price to the performance obligations identified in the contract. Revenue is recognized as those performance obligations are satisfied. We applied this new guidance retrospectively to all prior periods presented, and adoption of this new guidance did not have a significant quantitative impact on our consolidated financial statements. However, adoption of this guidance resulted in additional revenue-related disclosures in the notes to our consolidated financial statements.

Recent Developments

Institutional Investment

On February 6, 2020, we issued and sold an aggregate of approximately $40.0 million of shares of our common stock to a single institutional investor pursuant to our common stock Sales Agreement with Cowen and Company, LLC as the sales agent. In this transaction, we sold an aggregate of 2,077,500 shares of common stock at a price of $19.25 per share, resulting in net proceeds of approximately $39.2 million after a deduction of approximately $0.8 million in sales commissions. The shares in the offering were sold pursuant to a shelf registration statement declared effective by the Securities and Exchange Commission ("SEC") on May 31, 2018 and a prospectus supplement filed with the SEC on June 1, 2018.

75 Hayden lease

On January 14, 2020, we entered into a non-cancelable real property lease agreement for 61,282 square feet of office and laboratory space in Lexington, Massachusetts (the "Second Lexington Lease"). The original term is estimated to commence during the fourth quarter of 2020 and is for 125 months with options to extend the term for two additional successive periods of five years thereafter.

The aggregate total fixed rent is approximately $41.8 million with the annual fixed rental payments escalating from $3.6 million to $4.8 million during the original term. In addition to the fixed rent during the lease term, we will be responsible for certain customary operating expenses and real estate taxes specified in the agreement. This lease also contains customary default provisions allowing the landlord to terminate the lease or seek damages if we fail to cure certain breaches of our obligations under the lease within specified periods of time. We are also obligated to indemnify the landlord for certain losses incurred in connection with our use or occupancy of the premises and to deliver an irrevocable letter of credit or security deposit in the amount of $1.5 million.

Alexion option exercises

In November 2019, the Company and Alexion amended its agreement to clarify funding for certain manufacturing costs for each of the two initial targets and increased milestone payments for the additional targets if Alexion exercised its options for the two additional targets.

In December 2019, Alexion exercised its options for the exclusive rights to two additional targets within the complement pathway for the discovery and development of GalXC RNAi molecules. These exercises expand Dicerna and Alexion's existing research collaboration and license agreement to now encompass four targets within the complement pathway. In connection with the option exercises, Alexion paid Dicerna a total of $20.0 million, or $10.0 million in option exercise fees per additional target during December 2019.

Novo collaboration

On November 15, 2019, we entered into a Collaboration and License Agreement with Novo (the "Novo Collaboration Agreement"). Refer to *"Part II, Item 8 — Note 8 – Collaborative Research and License Agreements"* for further information regarding the Novo collaboration.

Roche collaboration

On October 30, 2019, we entered into a Collaboration and License Agreement with Roche (the "Roche Collaboration Agreement"). Refer to *"Part II, Item 8 — Note 8 – Collaborative Research and License Agreements"* for further information regarding the Roche collaboration agreement.

Boulder lease

On August 26, 2019, we entered into a non-cancelable real property lease agreement for 15,781 square feet of office space in Boulder, Colorado (the "Boulder Lease"). On February 4, 2020, we amended this lease to allow for the rental of an additional 6,985 square feet of office space. We intend to relocate our currently remote Colorado employees to a portion of this facility upon lease commencement, which we anticipate will occur in the first quarter of 2020, and plan to occupy the remainder of the space commencing in the second quarter of 2020.

The term of the Boulder Lease is 87 full calendar months plus any partial month from the commencement date to the end of the month in which the commencement date falls. The Boulder Lease commences on the earlier of the date on which (a) we occupy any portion of the facility and begin conducting business therein, (b) the landlord delivers the facility to us with the work in the facility substantially completed, or (c) the work in the facility would have been substantially completed but for the occurrence of any delays caused by us. The Boulder Lease provides for an aggregate fixed rent of approximately $4.4 million during the 87-month term. In addition to the annual fixed rent, we will be responsible for certain customary operating expenses and real estate taxes specified in the agreement.

Cambridge sublease

On January 4, 2019, we entered into a non-cancelable real property sublease agreement for approximately 9,653 square feet of office space in Cambridge, Massachusetts ("Cambridge Sublease"). The term of the sublease commenced on January 11, 2019, the date that the landlord provided written consent to the Cambridge Sublease, and extends through the sublease expiration date of

July 30, 2021. The Cambridge Sublease provides for an aggregate fixed rent of approximately $0.8 million during the term of the sublease.

Lexington lease

On January 2, 2019, we entered into a non-cancelable real property lease agreement for 80,872 square feet of laboratory and office space in Lexington, Massachusetts (the "Lexington Lease"). We moved our corporate headquarters and research facility to this location in the fourth quarter of 2019.

The Original Term of the Lexington Lease is seven years, commencing on November 3, 2019. We have options to extend the term of the lease for two additional successive periods of five years each (the "Extension Periods").

Annual fixed rent is approximately $3.9 million for the first 12-month period during the Original Term, increasing on an annual basis until reaching approximately $4.7 million for the seventh 12-month period during the Original Term. The Lexington Lease provides for an aggregate fixed rent of approximately $30.1 million during the seven-year Original Term. We will agree upon annual fixed rent during the Extension Periods with the landlord following our provision of notice of intention to exercise an extension option. If we cannot reach an agreement on annual fixed rent during an Extension Period with the landlord, we will have the right to seek, subject to the terms of the Lexington Lease, a broker determination of the prevailing market rent, and the annual fixed rent during such Extension Period will be the prevailing market rent determined by the broker.

In addition to the annual fixed rent, we will be responsible for certain customary operating expenses and real estate taxes specified in the agreement. The Lexington Lease also contains customary default provisions allowing the landlord to terminate the lease or seek damages if we fail to cure certain breaches of our obligations under the lease within specified periods of time. In addition, we will be obligated to indemnify the landlord for certain losses incurred in connection with our use or occupancy of the premises.

Financial Operations Overview

Revenue

Our revenue from collaboration arrangements to date has been generated primarily through research funding, license fees, option exercise fees, and preclinical development payments under our research collaboration arrangements with Lilly, Alexion, and BI. We have not generated any commercial product revenue, nor do we expect to generate any product revenue in the near-term future.

In the future, we may generate revenue from a combination of research and development payments, license fees and other upfront payments, milestone payments, product sales, and royalties in connection with our current or future collaborations with partners. We expect that any revenue we generate will fluctuate in future periods as a result of the timing of our or our collaborators' achievement of preclinical, clinical, regulatory, and commercialization milestones, to the extent achieved, the timing and amount of any payments to us relating to such milestones, and the extent to which any of our product candidates are approved and successfully commercialized by us or a collaborator.

Research and development expenses

Research and development expenses consist of costs associated with our research activities, including discovery and development of our GalXC molecules and drug delivery technologies, clinical and preclinical development activities, and research activities under our research collaboration and license agreements. Our research and development expenses include:

- direct research and development expenses incurred under arrangements with third parties, such as contract research organizations, contract manufacturing organizations, and consultants;
- platform-related lab expenses, including lab supplies, license fees, and consultants;
- employee-related expenses, including salaries, benefits, and stock-based compensation expense; and
- facilities, depreciation, and other allocated expenses, which include direct and allocated expenses for rent and maintenance of facilities, depreciation of leasehold improvements and equipment, and laboratory and other supplies.

We expense research and development costs as they are incurred. We account for non-refundable advance payments for goods and services that will be used in future research and development activities as expenses when the service has been performed or when the goods have been received. A significant portion of our research and development costs are not tracked by project as they benefit multiple projects or our technology platform.

General and administrative expenses

General and administrative expenses consist primarily of salaries and related benefits, including stock-based compensation, related to our executive, finance, legal, business development, commercial, and support functions. Other general and administrative expenses include travel expenses, professional legal fees (excluding litigation expenses), audit, tax, and other professional services, and allocated facility-related costs not otherwise included in research and development expenses.

Litigation expense

Litigation expense consists of legal fees and expenses solely related to the litigation with Alnylam Pharmaceuticals, Inc. ("Alnylam") that was settled in 2018.

Interest income

Interest income consists of income earned on our cash and cash equivalents, held-to-maturity investments, and restricted cash equivalents.

Interest expense

Interest expense represents interest expense incurred on a long-term payable with Alnylam, which was paid in the first quarter of 2019.

Results of Operations

Comparison of the years ended December 31, 2019 and 2018

The following table summarizes the results of our operations for the periods indicated (amounts in thousands, except percentages):

	YEAR ENDED DECEMBER 31,			
	2019	2018	$ CHANGE	% CHANGE
Revenue	$ 23,904	$ 6,176	$ 17,728	287.0 %
Operating expenses:				
Research and development	109,339	45,711	63,628	139.2 %
General and administrative	42,751	21,685	21,066	97.1 %
Litigation expense	—	29,132	(29,132)	(100.0)%
Total operating expenses	152,090	96,528	55,562	57.6 %
Loss from operations	(128,186)	(90,352)	(37,834)	41.9 %
Other income (expense):				
Interest income	7,537	2,102	5,435	258.6 %
Interest expense	(3)	(603)	600	(99.5)%
Other income (expense)	193	—	193	— %
Total other income, net	7,727	1,499	6,228	415.5 %
Net loss attributable to common stockholders	$ (120,459)	$ (88,853)	$ (31,606)	35.6 %

Revenue

For the year ended December 31, 2019, revenue reflects $13.1 million, $4.4 million, and $6.3 million from the Lilly, Alexion and BI collaborations, respectively, compared to $0.1 million and $6.1 million from the Alexion and BI collaborations, respectively, for the year ended December 31, 2018. The increases in Lilly and Alexion revenue for the year ended December 31, 2019 reflect

increased activities under each agreement, as both agreements are recognized as revenue on a cost-to-cost measure of progress method. No revenue was recognized under the Novo and Roche agreements during the year ended December 31, 2019, as work had not yet commenced under either agreement.

Research and development expenses

The following table summarizes our research and development expenses incurred during the periods indicated (amounts in thousands, except percentages):

	YEAR ENDED DECEMBER 31,			
	2019	2018	$ CHANGE	% CHANGE
Direct research and development expenses	$ 59,433	$ 22,912	$ 36,521	159.4%
Platform-related expenses	13,222	6,325	6,897	109.0%
Employee-related expenses	31,173	13,130	18,043	137.4%
Facilities, depreciation, and other expenses	5,511	3,344	2,167	64.8%
Total	$ 109,339	$ 45,711	$ 63,628	139.2%

Research and development expenses increased for the year ended December 31, 2019 compared to the year ended December 31, 2018 primarily due to direct research and development expenses and employee-related expenses. The $36.5 million increase in direct research and development expenses included a $20.1 million increase in manufacturing costs, primarily for drug substance to support our clinical studies, and an $11.9 million increase in clinical study costs, reflecting increased activities associated with our nedosiran and RG6346 programs. Research and development expenses were also impacted by a $18.0 million increase in employee-related expenses, which include salaries, benefits, and stock-based compensation. The increase in employee-related expenses is a result of a 124% increase in research and development headcount necessary to support our collaboration agreements and expanding pipeline. Finally, platform-related expenses increased $6.9 million primarily due to higher raw materials and lab supplies costs of $5.0 million.

We expect our overall research and development expenses to continue to increase for the foreseeable future as we ramp our clinical manufacturing activities, continue clinical activities associated with three of our core product candidates, initiate activities under the Novo and Roche agreements, and continue activities under the Lilly, Alexion, and BI agreements.

General and administrative expenses

General and administrative expenses were $42.8 million and $21.7 million for the years ended December 31, 2019 and 2018, respectively. The $21.1 million increase in general and administrative expenses is primarily due to increases of $10.0 million in employee-related compensation, including salaries, benefits, and stock-based compensation, due to a 220% increase in headcount necessary to support our growing operations. In addition, general and administrative expenses increased $5.7 million related to professional fees and consulting costs.

We expect general and administrative expenses to continue to increase in 2020, as compared to 2019, largely due to investments in staffing and market readiness activities.

Litigation expense

Litigation expenses of $29.1 million recorded during the year ended December 31, 2018 are comprised solely of litigation and settlement expenses associated with the litigation with Alnylam.

Interest income

Interest income is comprised of interest earned from our money market accounts and held-to-maturity investments. Interest income was $7.5 million and $2.1 million for the years ended December 31, 2019 and 2018, respectively. The increase was primarily due to higher held-to-maturity investments balances amounts during the year ended December 31, 2019 primarily resulting from our follow-on public offering in September 2018 and funds received from the collaboration agreements with Lilly and Alexion in the fourth quarter of 2018.

Interest expense

Interest expense of $0.6 million during the year ended December 31, 2018 represents interest expense incurred on our litigation settlement payable.

Comparison of the years ended December 31, 2018 and 2017

The following table summarizes the results of our operations for the periods indicated (amounts in thousands, except percentages):

	YEAR ENDED DECEMBER 31,			
	2018	2017	$ CHANGE	% CHANGE
Revenue	$ 6,176	$ 1,030	$ 5,146	499.6 %
Operating expenses:				
Research and development	45,711	35,888	9,823	27.4 %
General and administrative	21,685	16,838	4,847	28.8 %
Litigation expense	29,132	9,043	20,089	222.1 %
Total operating expenses	96,528	61,769	34,759	56.3 %
Loss from operations	(90,352)	(60,739)	(29,613)	48.8 %
Other income (expense):				
Interest income	2,102	539	1,563	290.0 %
Interest expense	(603)	—	(603)	— %
Total other income, net	1,499	539	960	178.1 %
Net loss	(88,853)	(60,200)	(28,653)	47.6 %
Dividends on redeemable convertible preferred stock	—	(10,111)	10,111	(100.0)%
Deemed dividend related to beneficial conversion feature of redeemable convertible preferred stock	—	(6,144)	6,144	(100.0)%
Deemed dividend on conversion of redeemable convertible preferred stock	—	(3,837)	3,837	(100.0)%
Net loss attributable to common stockholders	$ (88,853)	$ (80,292)	$ (8,561)	10.7 %

Revenue

During the year ended December 31, 2018, revenue increased $5.1 million compared to 2017 due to the recognition of a full year of revenue under the BI Agreement and our entry into the Alexion Collaboration Agreement.

Revenue recognized under the BI Agreement during the years ended December 31, 2018 and 2017 was $6.1 million and $1.0 million, respectively. This revenue represents the periodic amortization of a non-refundable upfront payment of $10.0 million and $0.3 million of certain reimbursable costs pursuant to the BI Agreement, which was signed in the fourth quarter of 2017.

Revenue recognized under the Alexion Collaboration Agreement during the year ended December 31, 2018 was $0.1 million. At December 31, 2018, the $31.3 million of consideration received and allocated to the revenue element of the arrangement relates to our partially unsatisfied performance obligations and is recorded as a contract liability presented in deferred revenue, of which $11.7 million was included in the current portion of deferred revenue. As of December 31, 2018, we expected to recognize this amount over the remaining research program term, which we estimated would extend through the fourth quarter of 2023.

Research and development expenses

The following table summarizes our research and development expenses incurred for the periods indicated (amounts in thousands, except percentages):

	YEAR ENDED DECEMBER 31,			
	2018	2017	$ CHANGE	% CHANGE
Direct research and development expenses	$ 22,912	$ 15,898	$ 7,014	44.1 %
Platform-related expenses	6,325	6,611	(286)	(4.3)%
Employee-related expenses	13,130	10,155	2,975	29.3 %
Facilities, depreciation, and other expenses	3,344	3,224	120	3.7 %
Total	$ 45,711	$ 35,888	$ 9,823	27.4 %

Research and development expenses increased for the year ended December 31, 2018 compared to the year ended December 31, 2017 primarily due to direct research and development expenses. The $7.0 million increase in direct research and development expenses is primarily due to increases in clinical development spending of $5.2 million for nedosiran and $1.1 million for RG6346. In addition, employee-related expenses increased $3.0 million during the year ended December 31, 2018 as a result of increased headcount necessary to support our growth.

Research and development expenses for the years ended December 31, 2018 and 2017 were additionally offset by $0.7 million and $1.1 million of grant income, respectively.

General and administrative expenses

General and administrative expenses were $21.7 million and $16.8 million for the years ended December 31, 2018 and 2017, respectively. The increase of $4.8 million is primarily due to increases of $1.9 million in consulting costs, $1.0 million in compensation for our board of directors, and $0.8 million in salary and benefits expense. Our use of consultants increased largely due to business development consulting services and accounting support for the implementation of new accounting standards and preparation for our planned compliance with Sarbanes-Oxley Section 404(b) in 2019, as well as to support new product initiatives. The increase in board of directors' compensation is largely related to stock-based compensation. Salaries and benefits expenses increased as a result of increased headcount required to support our growth.

Litigation expenses

Litigation expenses are comprised solely of litigation and settlement expenses associated with the litigation with Alnylam. Litigation expenses increased predominantly due to $24.7 million of settlement expenses recorded related to the Settlement Agreement during the year ended December 31, 2018.

Interest income

Interest income is comprised primarily of interest earned from our money market accounts and held-to-maturity investments. Interest income was $2.1 million and $0.5 million for the years ended December 31, 2018 and 2017, respectively. The increase was primarily due to higher held-to-maturity investments balances amounts during the year ended December 31, 2018 primarily resulting from our follow-on public offering in September 2018 and funds received from the collaboration agreements with Lilly and Alexion in the fourth quarter of 2018.

Interest expense

Interest expense of $0.6 million during the year ended December 31, 2018 represents interest expense incurred on our litigation settlement payable.

Dividends

There were no dividends recorded related to redeemable convertible preferred stock for the year ended December 31, 2018, as all shares of the redeemable convertible preferred stock were converted into shares of our common stock on December 18, 2017.

Net loss attributable to common stockholders

Net loss attributable to common stockholders was $88.9 million and $80.3 million for the years ended December 31, 2018 and 2017, respectively. The overall increase in net loss attributable to common stockholders was due to the increase in net loss from the prior year of $28.7 million, which was partially offset by $10.1 million of dividends and deemed dividends on redeemable convertible preferred shares, as well as $10.0 million of deemed dividends related to the beneficial conversion feature ("BCF") and conversion of redeemable convertible preferred shares in 2017.

Liquidity and Capital Resources

Overview

We have historically funded our operations primarily through the public offering and private placement of our securities and consideration received from our collaborative arrangements with Lilly, Alexion, and BI. As of December 31, 2019, we had cash, cash equivalents, and held-to-maturity investments of $348.9 million compared to $302.6 million as of December 31, 2018.

On May 31, 2018, a universal shelf registration statement on Form S-3 permitting the sale of up to $250.0 million of our common stock and other securities was declared effective by the SEC. In September 2018, we sold an aggregate of 8,832,565 shares of our common stock for gross proceeds of $115.0 million pursuant to this registration statement. We intend to use the net proceeds from the offering for preclinical studies and clinical trials, and to use the remainder of any net proceeds for continued technology platform development, working capital, and general corporate purposes.

On November 7, 2019, we filed a universal shelf registration statement as a well-known seasoned issuer on Form S-3 permitting the sale of common stock, preferred stock, debt securities, warrants, other rights, or units. We may offer and sell these securities in one or more issuances at prices and on terms that will be determined at the time of offering.

In January 2020, we received a $200.0 million upfront payment from Roche associated with the Roche Collaboration Agreement executed in October 2019 and a $175.0 million upfront payment from Novo associated with the Novo Collaboration Agreement executed in November 2019.

On February 6, 2020, we issued and sold an aggregate of approximately $40.0 million of shares of our common stock to a single institutional investor pursuant to our common stock Sales Agreement with Cowen and Company, LLC as the sales agent. In this transaction, we sold an aggregate of 2,077,500 shares of common stock at a price of $19.25 per share, resulting in net proceeds of approximately $39.2 million after a deduction of approximately $0.8 million in sales commissions. The shares in the offering were sold pursuant to a shelf registration statement declared effective by the SEC on May 31, 2018 and a prospectus supplement filed with the SEC on June 1, 2018.

We believe that our cash, cash equivalents, and held-to-maturity investments, together with the $375.0 million in upfront payments from our recently announced collaboration agreements with Novo and Roche, provides us with sufficient resources to continue our planned operations and clinical activities into 2023.

Cash flows

The following table shows a summary of our consolidated cash flows for the periods indicated (amounts in thousands):

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
Net cash (used in) provided by operating activities	$ (692)	$ 18,298	$ (45,327)
Net cash provided by (used in) investing activities	$ 49,531	$ (202,731)	$ (19,852)
Net cash provided by financing activities	$ 52,888	$ 169,883	$ 112,731

Operating activities

Net cash used in operating activities was $0.7 million compared to net cash provided by operating activities of $18.3 million for the years ended December 31, 2019 and 2018, respectively. The $19.0 million decrease in net cash provided by operating activities for the year ended December 31, 2019 was primarily due to an increased operating loss of $31.6 million. The decrease in cash was also impacted by a $21.0 million decrease in the litigation settlement payable as a result of the change in year over year activity. These decreases were offset by an increase in deferred revenue of $37.9 million associated with our collaboration agreements.

Net cash provided by operating activities was $18.3 million and net cash used in operating activities was $45.3 million for the years ended December 31, 2018 and 2017, respectively. The $63.6 million net increase in cash provided by operating activities was primarily due to an increase of $164.6 million in deferred revenue due to consideration received in connection with the Lilly and Alexion collaboration agreements. This amount was partially offset by a $100.0 million increase in contract receivables associated with the upfront payment for the Lilly collaboration agreement.

Investing activities

Net cash provided by investing activities for the year ended December 31, 2019 was $49.5 million, compared to net cash used in investing activities of $202.7 million for the year ended December 31, 2018. The decrease of $252.3 million in net cash used in investing activities during 2019 primarily relates to a $337.0 million increase in proceeds from the maturities of held-to-maturity investments that were partially offset by a $78.7 million increase in purchases of held-to-maturity investments.

Net cash used in investing activities for the year ended December 31, 2018 was $202.7 million, compared to net cash used in investing activities of $19.9 million for the year ended December 31, 2017. The increase of $182.9 million in net cash used in investing activities during 2018 primarily relates to an increase of $193.7 million in purchases of held-to-maturity investments as a result of cash received from our follow-on public offering in September 2018, as well as the collaboration agreements signed with Lilly and Alexion in October 2018. This increase was partially offset by an $11.0 million increase in the maturities of held-to-maturity securities.

Financing activities

Net cash provided by financing activities was $52.9 million and $169.9 million for the years ended December 31, 2019 and 2018, respectively. The decrease in cash provided by financing activities of $117.0 million was primarily due to the receipt of $108.1 million in net proceeds in September 2018 from a follow-on public offering of our common stock.

Net cash provided by financing activities was $169.9 million and $112.7 million for the years ended December 31, 2018 and 2017, respectively. The increase in cash provided by financing activities of $57.2 million was primarily due to receipt of $124.6 million in proceeds from the issuance of common stock net of underwriters' commissions associated with our follow-on public offering in September 2018 and from the share issuance agreements with Lilly and Alexion during the fourth quarter of 2018. This amount was partially offset by $69.3 million in proceeds from the redeemable convertible preferred stock financing in 2017.

Funding requirements

We expect that our primary uses of capital will continue to be commercialization readiness and launch, if approved, third-party clinical research and development services and manufacturing costs, compensation and related expenses, laboratory and related supplies, legal and other regulatory expenses, and general overhead costs. Because of the numerous risks and uncertainties associated with the development and commercialization of our product candidates and the extent to which we may enter into additional collaborations with third parties to participate in their development and commercialization, we are unable to estimate the amounts of capital outlays and operating expenditures associated with our anticipated development activities. However, based on our current operating plan, we believe that our available cash, cash equivalents, and held-to-maturity investments will be sufficient to fund the execution of our current clinical and operating plans into 2023. We based this estimate on assumptions that may prove to be incorrect, and we could utilize our available capital resources sooner than we currently expect.

Our forecast of the period of time through which our financial resources will be adequate to support our operations is a forward-looking statement that involves risks and uncertainties, and actual results could vary materially as a result of a number of factors. Our future capital requirements are difficult to forecast and will depend on many factors, including:

- the potential receipt of any milestone payments under the Novo Collaboration Agreement, Roche Collaboration Agreement, Lilly Collaboration Agreement, Alexion Collaboration Agreement and BI Agreements;
- the terms and timing of any other collaboration, licensing, and other arrangements that we may establish;
- the initiation, progress, timing, and completion of preclinical studies and clinical trials for our potential product candidates;
- our alignment with the U.S. Food and Drug Administration on regulatory approval requirements;
- the number and characteristics of product candidates that we pursue;
- the outcome, timing, and cost of regulatory approvals;
- delays that may be caused by changing regulatory requirements;
- the cost and timing of hiring new employees to support our continued growth;
- the costs involved in filing and prosecuting patent applications and enforcing and defending patent claims;
- the costs of filing and prosecuting intellectual property rights and enforcing and defending any intellectual property-related claims;
- the costs of responding to and defending ourselves against complaints and potential litigation;

- the costs and timing of procuring clinical and commercial supplies for our product candidates;
- the extent to which we acquire or in-license other product candidates and technologies; and
- the extent to which we acquire or invest in other businesses, product candidates, or technologies.

Until such time, if ever, that we generate product revenue, we expect to finance our future cash needs through a combination of public or private equity offerings, debt financings, and research collaboration and license agreements.

Please see the risk factors set forth in Part I, Item 1A – "Risk Factors" in this Annual Report on Form 10-K for additional risks associated with our substantial capital requirements.

Contractual Obligations and Commitments

The following is a summary of our contractual obligations as of December 31, 2019 (amounts in thousands):

	Payments Due By Period*				
	Total	Less Than 1 Year	More Than 1 Year and Less Than 3 Years	More Than 3 Years and Less Than 5 Years	More Than 5 Years
Operating lease obligations	$ 31,960	$ 5,968	$ 8,416	$ 8,723	$ 8,853
Finance lease obligations	$ 240	$ 52	$ 96	$ 92	$ —

* Represents future minimum lease payments under our existing non-cancelable operating leases for our offices and laboratory space and our finance lease for equipment. Excluded from the table above are fixed lease payments of $4.4 million associated with our lease of office and laboratory space in Boulder, Colorado and $41.8 million associated with our newest lease in Lexington, Massachusetts. Such lease payments were excluded, as the commencement dates have not yet occurred for accounting purposes and lease liabilities have not yet been recognized on our consolidated balance sheet.

We also have obligations to make future payments to licensors that become due and payable on the achievement of certain development, regulatory, and commercial milestones. We have not included any such potential obligations on our consolidated balance sheet or in the table above, since the achievement and timing of these milestones were not probable or estimable as of December 31, 2019.

Off-Balance Sheet Arrangements

As of December 31, 2019, we did not have any relationships with unconsolidated entities or financial partnerships, such as entities often referred to as "special purpose" entities, which would have been established for the purpose of facilitating off-balance sheet arrangements or other contractually narrow or limited purposes.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

The primary objectives of our investment activities are to ensure liquidity and to preserve principal, while at the same time maximizing the income we receive from our marketable securities without significantly increasing risk. Some of the securities that we invest in may have market risk related to changes in interest rates. As of December 31, 2019, we had cash, cash equivalents, and held-to-maturity investments of $348.9 million. Our primary exposure to market risk is interest rate sensitivity, which is affected by changes in the general level of U.S. interest rates. Due to the short-term maturities of our cash and cash equivalents and held-to-maturity investments and the low risk profile of our investments, an immediate 100 basis point change in interest rates by the U.S. federal reserve would not have a material effect on the fair market value of our cash, cash equivalents, or held-to-maturity investments. To minimize the risk in the future, we intend to maintain our portfolio of cash, cash equivalents, and held-to-maturity investments in a variety of securities, including commercial paper, money market funds, and government securities.

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

DICERNA PHARMACEUTICALS, INC.
INDEX TO FINANCIAL STATEMENTS

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Board of Directors and Stockholders of Dicerna Pharmaceuticals, Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Dicerna Pharmaceuticals, Inc. and subsidiaries (the "Company") as of December 31, 2019 and 2018, the related consolidated statements of operations, changes in redeemable convertible preferred stock and stockholders' equity, and cash flows, for each of the three years in the period ended December 31, 2019, and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2019 and 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2019, in conformity with accounting principles generally accepted in the United States of America.

We have also audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control - Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission and our report dated February 27, 2020, expressed an unqualified opinion on the Company's internal control over financial reporting.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matters

The critical audit matter communicated below is a matter arising from the current-period audit of the financial statements that was communicated or required to be communicated to the audit committee and that (1) relates to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective, or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the financial statements, taken as a whole, and we are not, by communicating the critical audit matter below, providing a separate opinion on the critical audit matter or on the accounts or disclosures to which it relates.

Revenue from Collaborative Arrangements - Refer to Notes 2 and 8 to the financial statements.

Critical Audit Matter Description
The Company recognizes revenue upon transfer of control of promised goods or services to customers in an amount that reflects the consideration the Company expects to receive in exchange for those goods or services. The Company's collaboration and license agreements contain certain promises that together represent single performance obligations because the promises to transfer individual
services are not distinct from other promises in the contracts.

Significant judgment is exercised by the Company in determining revenue recognition for these customer arrangements, and includes
the following:

- Determination of whether goods and services are considered distinct performance obligations that should be accounted for separately versus combined, such as licenses of intellectual property and related services that are sold in license and development arrangements.

- Determination of stand-alone selling prices for each distinct performance obligation and for goods and services that are not sold separately.

- Estimating the total cost of fulfilling certain performance obligations that are satisfied over time, which impacts the timing of revenue recognition for such performance obligations.

Given these factors, the related audit effort in evaluating management's judgments in determining revenue recognition for these customer agreements was extensive and required a high degree of auditor judgment.

How the Critical Audit Matter Was Addressed in the Audit

Our principal audit procedures related to the Company's revenue recognition for these customer agreements included the following:

- We tested the effectiveness of internal controls related to the identification of distinct performance obligations and the determination of the timing of revenue recognition.
- We evaluated management's significant accounting policies related to these customer agreements for reasonableness
- For arrangements that became effective during the year ended December 31, 2019, we performed the following procedures:
    - Obtained and read contract source documents for each selection and other documents that were part of the agreement.
    - Tested management's identification of significant terms for completeness, including the identification of distinct performance obligations.
    - Assessed the terms in the customer agreement and evaluated the appropriateness of management's application of their accounting policies, along with their use of estimates, in the determination of revenue recognition conclusions.
    - We evaluated the reasonableness of management's estimate of stand-alone selling prices for performance obligations that are not sold separately.
- We evaluated the estimates of total contract costs to fulfill performance obligations by performing the following procedures:
    - We compared costs incurred for activities completed to date to the costs forecasted for those activities.
    - We evaluated management's ability to achieve the estimates of total contract cost and profit by performing corroborating inquiries with the Company's operations teams and comparing the information obtained to estimates included in the accounting records.
    - We compared management's estimates for the selected contracts to historical experience and original budgets, when applicable.
- We tested the mathematical accuracy of management's calculations of revenue and the associated timing of revenue recognized in the financial statements.

/s/ Deloitte & Touche LLP

Boston, Massachusetts

February 27, 2020

We have served as the Company's auditor since 2008.

DICERNA PHARMACEUTICALS, INC.
CONSOLIDATED BALANCE SHEETS
(in thousands, except share data and par value)

	DECEMBER 31,	
	2019	2018
ASSETS		
CURRENT ASSETS:		
Cash and cash equivalents	$ 152,816	$ 54,239
Held-to-maturity investments	196,065	248,387
Contract receivables	200,354	100,000
Prepaid expenses and other current assets	6,934	2,888
Total current assets	556,169	405,514
NONCURRENT ASSETS:		
Property and equipment, net	7,076	2,718
Right-of-use operating assets, net	30,102	—
Restricted cash equivalents	3,894	744
Other noncurrent assets	168	65
Total noncurrent assets	41,240	3,527
TOTAL ASSETS	$ 597,409	$ 409,041
LIABILITIES AND STOCKHOLDERS' EQUITY		
CURRENT LIABILITIES:		
Accounts payable	$ 6,077	$ 5,013
Accrued expenses and other current liabilities	20,042	9,649
Lease liability, current	3,358	—
Litigation settlement payable	—	10,500
Deferred revenue, current	212,258	68,893
Total current liabilities	241,735	94,055
NONCURRENT LIABILITIES:		
Lease liability, noncurrent	20,141	—
Deferred revenue, noncurrent	182,730	114,293
Other noncurrent liabilities	608	—
Total noncurrent liabilities	203,479	114,293
TOTAL LIABILITIES	445,214	208,348
COMMITMENTS AND CONTINGENCIES (NOTE 15)		
STOCKHOLDERS' EQUITY:		
Preferred stock, $0.0001 par value – 5,000,000 shares authorized; no shares issued or outstanding at December 31, 2019 or 2018	—	—
Common stock, $0.0001 par value – 150,000,000 shares authorized; 71,573,196 and 68,210,742 shares issued and outstanding at December 31, 2019 and 2018, respectively	7	7
Additional paid-in capital	677,504	605,495
Accumulated deficit	(525,316)	(404,809)
Total stockholders' equity	152,195	200,693
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY	$ 597,409	$ 409,041

The accompanying notes are an integral part of these consolidated financial statements.

DICERNA PHARMACEUTICALS, INC.
CONSOLIDATED STATEMENTS OF OPERATIONS
(in thousands, except share and per share data)

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
Revenue	$ 23,904	$ 6,176	$ 1,030
Operating expenses:			
Research and development	109,339	45,711	35,888
General and administrative	42,751	21,685	16,838
Litigation expense	—	29,132	9,043
Total operating expenses	152,090	96,528	61,769
Loss from operations	(128,186)	(90,352)	(60,739)
Other income (expense):			
Interest income	7,537	2,102	539
Interest expense	(3)	(603)	—
Other income (expense)	193	—	—
Total other income, net	7,727	1,499	539
Net loss	(120,459)	(88,853)	(60,200)
Dividends on redeemable convertible preferred stock	—	—	(10,111)
Deemed dividend related to beneficial conversion feature of redeemable convertible preferred stock	—	—	(6,144)
Deemed dividend on conversion of redeemable convertible preferred stock	—	—	(3,837)
Net loss attributable to common stockholders	$ (120,459)	$ (88,853)	$ (80,292)
Net loss per share attributable to common stockholders – basic and diluted	$ (1.76)	$ (1.60)	$ (3.66)
Weighted average common shares outstanding – basic and diluted	68,428,046	55,616,092	21,917,415

The accompanying notes are an integral part of these consolidated financial statements.

DICERNA PHARMACEUTICALS, INC.
CONSOLIDATED STATEMENTS OF CHANGES IN REDEEMABLE CONVERTIBLE PREFERRED STOCK AND STOCKHOLDERS' EQUITY
(in thousands, except share data)

	REDEEMABLE CONVERTIBLE PREFERRED STOCK		COMMON STOCK		ADDITIONAL PAID-IN CAPITAL	ACCUMULATED DEFICIT	TOTAL STOCKHOLDERS' EQUITY
	SHARES	AMOUNT	SHARES	AMOUNT			
BALANCE – January 1, 2017	—	—	20,753,001	2	296,962	(255,756)	41,208
Issuance of redeemable convertible preferred stock, net of issuance costs of $750	700,000	69,250	—	—	—	—	—
Issuance of common stock from public offering, net of underwriters' commissions and offering costs of $3,221	—	—	6,571,428	1	42,778	—	42,779
Beneficial conversion feature, redeemable convertible preferred stock	—	(6,144)	—	—	6,144	—	6,144
Deemed dividend, beneficial conversion feature, and redeemable convertible preferred stock	—	6,144	—	—	(6,144)	—	(6,144)
Accretion of share issuance costs on redeemable convertible preferred stock	—	750	—	—	(750)	—	(750)
Dividends declared, redeemable convertible preferred stock	55,124	9,361	—	—	(9,361)	—	(9,361)
Conversion of redeemable convertible preferred stock	(755,124)	(79,361)	24,206,663	2	79,359	—	79,361
Exercises of common stock options and sales of common stock under Employee Stock Purchase Plan	—	—	107,523	—	290	—	290
Vesting of restricted common stock	—	—	10,000	—	—	—	—
Settlement of restricted stock for tax withholding	—	—	(3,774)	—	(11)	—	(11)
Stock-based compensation expense	—	—	—	—	7,770	—	7,770
Net loss	—	—	—	—	—	(60,200)	(60,200)
BALANCE – December 31, 2017	—	—	51,644,841	5	417,037	(315,956)	101,086
Proceeds from issuance of common stock from public offering, net of underwriters' commissions and offering costs of $330	—	—	8,832,565	1	107,769	—	107,770
Issuance of common stock to Alnylam Pharmaceuticals, Inc.	—	—	983,208	—	10,315	—	10,315
Issuance of common stock to collaboration partners	—	—	6,250,019	1	60,411	—	60,412
Exercise of warrants to purchase common stock	—	—	45,710	—	49	—	49
Exercises of common stock options and sales of common stock under Employee Stock Purchase Plan	—	—	448,173	—	2,061	—	2,061
Vesting of restricted common stock	—	—	10,000	—	—	—	—
Settlement of restricted stock for tax withholding	—	—	(3,774)	—	(35)	—	(35)
Stock-based compensation expense	—	—	—	—	7,888	—	7,888
Net loss	—	—	—	—	—	(88,853)	(88,853)
BALANCE – December 31, 2018	—	—	68,210,742	7	605,495	(404,809)	200,693

DICERNA PHARMACEUTICALS, INC.
CONSOLIDATED STATEMENTS OF CHANGES IN REDEEMABLE CONVERTIBLE PREFERRED STOCK AND STOCKHOLDERS' EQUITY (CONTINUED)
(in thousands, except share data)

	REDEEMABLE CONVERTIBLE PREFERRED STOCK		COMMON STOCK		ADDITIONAL PAID-IN CAPITAL	ACCUMULATED DEFICIT	TOTAL STOCKHOLDERS' EQUITY
	SHARES	AMOUNT	SHARES	AMOUNT			
BALANCE – December 31, 2018	—	—	68,210,742	7	605,495	(404,809)	200,693
Exercises of common stock options and sales of common stock under Employee Stock Purchase Plan	—	—	1,082,472	—	7,402	—	7,402
Stock-based compensation expense (inclusive of the impact of adoption of ASU 2018-07)	—	—	—	—	18,779	43	18,822
Issuance of common stock to collaboration partners	—	—	2,279,982	—	45,828	—	45,828
Cumulative effect adjustment related to the adoption of ASC 842	—	—	—	—	—	(91)	(91)
Net loss	—	—	—	—	—	(120,459)	(120,459)
BALANCE – December 31, 2019	—	—	71,573,196	7	677,504	(525,316)	152,195

The accompanying notes are an integral part of these consolidated financial statements.

DICERNA PHARMACEUTICALS, INC.
CONSOLIDATED STATEMENTS OF CASH FLOWS
(in thousands)

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
CASH FLOWS FROM OPERATING ACTIVITIES:			
Net loss	(120,459)	$ (88,853)	$ (60,200)
Adjustments to reconcile net loss to net cash used in operating activities:			
Non-cash litigation expense	—	10,315	—
Stock-based compensation expense	18,822	7,888	7,770
Depreciation and amortization expense	1,254	774	778
Amortization of premium on investments	(3,559)	(1,126)	(169)
Lease expense	2,747	—	—
Other	(191)	12	51
Changes in operating assets and liabilities:			
Litigation settlement payable	(10,500)	10,500	—
Deferred revenue	211,803	173,916	9,270
Prepaid expenses and other assets	(3,856)	532	(1,459)
Accounts payable	2,067	(1,217)	626
Contract receivables	(100,354)	(100,000)	—
Withholding tax receivable	—	1,583	(1,583)
Accrued expenses and other liabilities	9,487	3,974	(411)
Lease liability	(8,966)	—	—
Other	1,013	—	—
Net cash (used in) provided by operating activities	(692)	18,298	(45,327)
CASH FLOWS FROM INVESTING ACTIVITIES:			
Maturities of held-to-maturity investments	418,000	81,000	70,000
Purchases of held-to-maturity investments	(362,120)	(283,372)	(89,719)
Purchases of property and equipment	(6,349)	(359)	(133)
Net cash provided by (used in) investing activities	49,531	(202,731)	(19,852)
CASH FLOWS FROM FINANCING ACTIVITIES:			
Proceeds from issuance of common stock, net of underwriters' commissions	—	108,099	43,225
Payments of common stock offering costs	(50)	(703)	(23)
Proceeds from issuance of redeemable convertible preferred stock	—	—	70,000
Redeemable convertible preferred stock issuance costs	—	—	(750)
Proceeds from issuance of common stock to collaboration partners	45,828	60,412	—
Proceeds from exercises of common stock warrants, stock options, and issuances under Employee Stock Purchase Plan	7,110	2,110	290
Settlement of restricted stock for tax withholding	—	(35)	(11)
Net cash provided by financing activities	52,888	169,883	112,731
NET INCREASE (DECREASE) IN CASH, CASH EQUIVALENTS, AND RESTRICTED CASH EQUIVALENTS	101,727	(14,550)	47,552
CASH, CASH EQUIVALENTS, AND RESTRICTED CASH EQUIVALENTS – Beginning of year	54,983	69,533	21,981
CASH, CASH EQUIVALENTS AND RESTRICTED CASH EQUIVALENTS – End of year	$ 156,710	$ 54,983	$ 69,533

DICERNA PHARMACEUTICALS, INC.
CONSOLIDATED STATEMENTS OF CASH FLOWS (CONTINUED)
(in thousands)

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
SUPPLEMENTAL CASH FLOW INFORMATION:			
NONCASH OPERATING ACTIVITIES:			
Right-of-use assets acquired through operating leases	$ 25,725	$ —	$ —
NONCASH INVESTING ACTIVITIES:			
Property and equipment purchases included in accounts payable and accrued expenses	$ 727	$ 1,648	$ 15
NONCASH FINANCING ACTIVITIES:			
Right-of-use assets acquired through finance leases	$ 193	$ —	$ —
Conversion of redeemable convertible preferred stock into common stock	$ —	$ —	$ 79,361
Dividends on redeemable convertible preferred stock	$ —	$ —	$ 10,111
Deemed dividend related to beneficial conversion feature of redeemable convertible preferred stock	$ —	$ —	$ 6,144
Deemed dividend on conversion of redeemable convertible preferred stock	$ —	$ —	$ 3,837
Common stock offering costs included in accounts payable or accrued expenses	$ —	$ 50	$ 423

The following table provides a reconciliation of cash, cash equivalents, and restricted cash equivalents reported within the consolidated balance sheets that sum to the total of the amounts shown in the consolidated statements of cash flows:

	DECEMBER 31,		
	2019	2018	2017
Cash and cash equivalents	$ 152,816	$ 54,239	$ 68,789
Restricted cash equivalents	3,894	744	744
Total cash, cash equivalents, and restricted cash equivalents shown in the consolidated statements of cash flows	$ 156,710	$ 54,983	$ 69,533

The accompanying notes are an integral part of these consolidated financial statements.

DICERNA PHARMACEUTICALS, INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS
(tabular amounts in thousands, except share and per share data and where otherwise noted)

1. DESCRIPTION OF BUSINESS

Business

Dicerna™ Pharmaceuticals, Inc. ("Dicerna" or the "Company"), a Delaware corporation founded in 2006 and headquartered in Lexington, Massachusetts, is a biopharmaceutical company using ribonucleic acid ("RNA") interference ("RNAi") to develop medicines that silence genes that cause or contribute to disease. The Company's proprietary GalXC™ technology is being applied to develop what we believe will be potent, selective, and safe RNAi therapies to treat diseases involving the liver, including rare diseases, chronic liver diseases, cardiometabolic diseases, and viral infectious diseases. As we further enhance our GalXC technology, we aim to extend our focus beyond the liver to include central nervous system diseases and diseases involving other bodily tissues. Dicerna aims to treat disease by addressing the underlying causes of illness to address a broad range of diseases, focusing on target genes where connections between gene and disease are well understood and documented. Dicerna intends to discover, develop, and commercialize novel therapeutics either on its own or in collaboration with pharmaceutical partners. Dicerna has strategic collaborations with Novo Nordisk A/S ("Novo"), F. Hoffmann-La Roche Ltd and Hoffmann-La Roche Inc. (together, "Roche"), Eli Lilly and Company ("Lilly"), Alexion Pharmaceuticals, Inc. (together with its affiliates, "Alexion"), and Boehringer Ingelheim International GmbH ("BI").

Liquidity

The Company had cash, cash equivalents, and held-to-maturity investments of $348.9 million as of December 31, 2019. The Company believes that its current cash, cash equivalents, and held-to-maturity investments as of December 31, 2019 will be sufficient to fund the execution of its current clinical and operating plan into 2023. This estimate assumes no new funding from additional collaboration agreements or from external financing events and no significant unanticipated changes in costs and expenses.

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of presentation

The accompanying consolidated financial statements have been prepared in accordance with accounting principles generally accepted in the United States of America ("GAAP") and include the accounts of Dicerna Pharmaceuticals, Inc. and its wholly owned subsidiaries. The Company believes that the financial statements as presented reflect all normal recurring adjustments necessary for a fair statement of the information for the periods presented. All intercompany balances and transactions have been eliminated in consolidation.

Significant judgments and estimates

The preparation of consolidated financial statements in conformity with GAAP requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the Company's consolidated financial statements, as well as the revenues and expenses incurred during the reporting periods. On an ongoing basis, the Company evaluates judgments and estimates, including those related to revenue recognition, stock-based compensation, and accrued expenses. The Company bases its estimates on historical experience and on various other factors that the Company believes are reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not apparent from other sources. Changes in estimates are reflected in reported results for the period in which they become known. Actual results could differ materially from those estimates.

Cash and cash equivalents

Cash and cash equivalents includes all highly liquid investments, including money market funds, maturing within 90 days from the date of purchase.

Restricted cash equivalents

Restricted cash equivalents are money market funds held in collateral accounts that are restricted to secure letters of credit for corporate lease activity. The letters of credit are required to be maintained throughout the terms of the leases.

Held-to-maturity investments

The Company invests its excess cash balances in short-term and long-term fixed-income investments. The Company determines the appropriate classification of investments at the time of purchase and re-evaluates such designation as of each balance sheet date. Debt securities carried at amortized cost are classified as held-to-maturity when the Company has the positive intent and ability to hold the securities to maturity.

The Company's investment policy mandates that, at the time of purchase, the maturity of each investment within its portfolio shall not exceed two years. In addition, the weighted-average maturity of the investment portfolio must not exceed one year.

Concentrations of credit risk and significant customers

Financial instruments that subject the Company to significant concentrations of credit risk consist of cash, cash equivalents, restricted cash equivalents, held-to-maturity investments, contract receivables, and the withholding tax receivable (see Note 8 – Collaborative Research and License Agreements). All of the Company's cash, cash equivalents, restricted cash equivalents, and held-to-maturity investments are invested in money market funds or United States ("U.S.") treasury securities that management believes to be of high credit quality.

The Company's revenues for the years ended December 31, 2019 and 2018 are primarily related to the Company's collaboration agreements which are concentrated among a few collaboration partners. For the year ended December 31, 2017, all of the Company's revenue related to one collaboration agreement. All revenues recognized by the Company to date were earned in the United States. Refer to Note 8 – Collaborative Research and License Agreements for composition of significant collaboration relationships.

The Company had $200.4 million and $100.0 million of contract receivables at December 31, 2019 and December 31, 2018, respectively. The balance of contract receivables at December 31, 2019 was primarily related to the non-refundable upfront payment due to the Company in connection with the Roche collaboration agreement. At December 31, 2018, the balance of the Company's contract receivables was solely related to the non-refundable upfront payment due to the Company in connection with the Lilly collaboration agreement (see Note 8 – Collaborative Research and License Agreements).

The Company does not currently own or operate any manufacturing facilities for the production of preclinical, clinical, or commercial quantities of any of its product candidates. For each product candidate, the Company currently contracts with manufacturers and expects to continue to do so to meet the preclinical and clinical requirements of its product candidates.

Fair Value Measurements

Fair value is an exit price, representing the amount that would be received from the sale of an asset or paid to transfer a liability in an orderly transaction between market participants. As such, fair value is a market-based measurement that should be determined based on assumptions that market participants would use in pricing an asset or liability. Valuation techniques used to measure fair value are performed in a manner to maximize the use of observable inputs and minimize the use of unobservable inputs. As a basis for considering such assumption, the accounting literature establishes a three-tier value hierarchy which prioritizes the inputs used in measuring fair value as follows:

- *Level 1* – observable inputs, such as quoted prices in active markets;
- *Level 2* – inputs other than the quoted prices in active markets that are observable either directly or indirectly; and
- *Level 3* – unobservable inputs for which there is little or no market data, which requires the Company to develop its own assumptions.

Property and equipment

Property and equipment are stated at cost. Major betterments are capitalized, whereas expenditures for maintenance and repairs which do not improve or extend the life of the respective assets are charged to operations as incurred. Depreciation is calculated and applied using the straight-line method over the estimated useful lives, as shown below:

ASSET CATEGORY	ESTIMATED USEFUL LIVES
Laboratory equipment	5 years
Office and computer equipment	3 - 5 years
Furniture and fixtures	5 years
Leasehold improvements	5 years or the remaining term of lease, if shorter

Construction-in-process is stated at cost, which includes the cost of construction and other direct costs attributable to the construction. No provision for depreciation and amortization expense is recorded related to construction-in-process until the relevant assets are completed and put into use. At December 31, 2019, the balance of construction-in-process includes costs associated with laboratory equipment under installation.

Impairment of long-lived assets

Long-lived assets are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of the asset may not be recoverable. When such events occur, the Company compares the carrying amounts of the assets to their undiscounted expected future cash flows. If this comparison indicates that there is an impairment, the amount of the impairment is calculated as the difference between the carrying value and fair value of the related asset. During the years ended December 31, 2019, 2018, and 2017, no impairments were recorded.

Leases

On January 1, 2019, the Company adopted the new lease standard, ASC 842, *Leases*, discussed below under the heading “Recent accounting pronouncements,” which is intended to increase transparency and comparability among organizations by requiring lessees to recognize most leases on their balance sheets and making targeted changes to lessor accounting. The most significant change arising from the new standard is the recognition of right-of-use (“ROU”) assets and lease liabilities for leases classified as operating leases. Under the standard, disclosures are required to enable financial statement users to assess the amount, timing, and uncertainty of cash flows arising from the leases.

The Company elected the package of three practical expedients that permitted an entity not to (a) reassess whether expired or existing contracts contain leases, (b) reassess lease classification for existing or expired leases, and (c) consider whether previously capitalized initial direct costs would be appropriate under the new standard. In adopting ASC 842, the Company elected not to bifurcate payments between lease and nonlease components associated with leases for office and laboratory real estate.

The Company determines if an arrangement is a lease at inception. Leases with a term greater than one year are presented on the balance sheet as ROU assets, lease liabilities and, if applicable, long-term lease liabilities. The Company has elected not to recognize leases with terms of one year or less on its balance sheet. At the commencement date, operating lease liabilities and their corresponding ROU assets are recorded based on the present value of future lease payments over the expected lease term. Certain adjustments to the ROU asset may be required for items such as initial direct costs paid or incentives received. Operating lease cost is recognized over the expected term on a straight-line basis.

The Company determines the expected term for its operating leases considering the noncancelable period of the lease, plus any additional periods covered by either (a) a Company option to extend (or not to terminate) the lease that the Company is reasonably certain to exercise, or (b) an option to extend (or not to terminate) the lease controlled by the lessor.

Segment and geographic information

Operating segments are defined as components (business activity from which it earns revenue and incurs expenses) of an enterprise about which discrete financial information is available and regularly reviewed by the chief operating decision maker in deciding how to allocate resources and in assessing performance. The Company, through its Chief Executive Officer in his role as chief operating decision maker, views Company operations and manages the business as one operating segment. All long-lived assets of the Company are located in the United States.

Research and development costs

Research and development costs consist of expenses incurred in performing research and development activities, including compensation and benefits for full-time research and development employees, an allocation of facility expenses and overhead expenses, and other external expenses. Research and development costs are expensed as incurred and were $109.3 million, $45.7 million, and $35.9 million for the years ending December 31, 2019, 2018, and 2017, respectively. Research and development costs that are paid in advance of performance are deferred as a prepaid expense and amortized over the service period as the services are provided.

Grants and credits

The Company sometimes receives assistance from third-party entities such as governmental or non-profit agencies. When assistance is received from a governmental entity, the Company first determines whether the payment represents revenue by considering factors such as whether a commercial purpose exists for the payments and whether the required activity to qualify for the assistance relates to the Company's ongoing activities. If the Company concludes that the assistance is revenue, the Company applies Accounting Standards Codification ("ASC") 606, *Revenue from Contracts with Customers*. If the assistance is in the form of an income tax credit, the Company applies the guidance in ASC 740, *Income Taxes*. When the Company determines that the assistance is not revenue and does not fall within the scope of ASC 740, it applies International Accounting Standard 20, *Accounting for Government Grants and Disclosure of Government Assistance*. Typically, government grants may be considered related to assets or related to income. The Company generally records grants from governmental and non-profit agencies related to income as a reduction in research and development expense. Grants are recognized when there is reasonable assurance that the Company will comply with the conditions attached to the grant arrangement and the grant will be received. Grant payments received related to research and development costs incurred prior to the approval of the qualifying program are recognized immediately upon approval of the program by the grantor.

Revenue recognition

The Company generates revenue from research collaboration and license agreements with customers. Goods and services in the agreements may include the grant of licenses for the use of the Company's technology, the provision of services associated with the research and development of product candidates, manufacturing services, and participation on joint steering committees. Such agreements may provide for consideration to the Company in the form of upfront payments; funding or reimbursement of research and development services; reimbursement of certain costs; option exercise payments; payments due upon the achievement of research, development, regulatory, and commercial-based milestones; and royalty payments on licensed products.

On January 1, 2018, the Company adopted the new revenue recognition standard, discussed below under the heading "Recent accounting pronouncements," which amended revenue recognition principles and provides a single, comprehensive set of criteria for revenue recognition. The new revenue standard applies to all contracts with customers except for contracts that are within the scope of other standards. The new guidance provides a five-step framework through which revenue is recognized when control of promised goods or services is transferred to a customer at an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services. To determine revenue recognition for arrangements that the Company concludes are within the scope of the new revenue recognition standard, management performs the following five steps: (i) identifies the contract(s) with a customer; (ii) identifies the performance obligations in the contract; (iii) determines the transaction price, including whether there are any constraints on variable consideration; (iv) allocates the transaction price to the performance obligations; and (v) recognizes revenue when (or as) the Company satisfies a performance obligation. At contract inception, once a contract is determined to be within the scope of the new revenue standard, Dicerna assesses whether individual goods or services promised within each contract are distinct and, therefore, represent a separate performance obligation. Goods and services that are determined not to be distinct are combined with other promised goods or services until a distinct bundle is identified. Dicerna allocates the transaction price (the amount of consideration to which the Company expects to be entitled in exchange for the promised goods or services) to each performance obligation and recognizes the associated revenue when (or as) each performance obligation is satisfied. The Company's estimate of the transaction price for each contract includes all variable consideration to which Dicerna expects to be entitled at each measuring period.

When two or more contracts are entered into with the same customer at or near the same time, the Company evaluates the contracts to determine whether the contracts should be accounted for as a single arrangement. Contracts are combined and accounted for as a single arrangement if one or more of the following criteria are met: (i) the contracts are negotiated as a package with a single commercial objective; (ii) the amount of consideration to be paid in one contract depends on the price or performance of the other contract; or (iii) the goods or services promised in the contracts (or some goods or services promised in each of the contracts) are a single performance obligation.

The evaluation of whether promised goods or services represent distinct performance obligations is subjective and requires the Company to make judgments about the promised goods and services and whether such goods and services are separable from the other aspects of the contract(s).

The transaction price is allocated among the performance obligations on a relative standalone selling price basis, and the applicable revenue recognition criteria are applied to each of the separate performance obligations. The Company may estimate the standalone selling price using a residual method when the selling price is highly variable because a representative standalone selling price is not discernible from past transactions or other observable evidence, or when the selling price is uncertain.

Determining the standalone selling price for performance obligations requires significant judgment. When an observable price of a promised good or service is not readily available, the Company considers relevant assumptions to estimate the standalone selling price, including, as applicable, market conditions, development timelines, probabilities of technical and regulatory success, reimbursement rates for personnel costs, forecasted revenues, potential limitations to the selling price of the product, and discount rates.

The Company applies judgment in determining whether a combined performance obligation is satisfied at a point in time or over time, and, if over time, concluding upon the appropriate method of measuring progress to be applied for purposes of recognizing revenue. The Company evaluates the measure of progress each reporting period and, as estimates related to the measure of progress change, related revenue recognition is adjusted accordingly. Changes in the Company's estimated measure of progress are accounted for on a cumulative catch-up basis as a change in accounting estimate and are recorded through earnings in the period of adjustment.

The Company receives payments from its licensees as established in each contract. Upfront payments and fees are recorded as deferred revenue upon receipt or when due and most often require deferral of revenue recognition to a future period until the Company performs its obligations under the underlying arrangements. Where applicable, amounts are recorded as contracts receivable when the Company's right to consideration is unconditional.

Licenses of intellectual property: If a license granted to a customer to use the Company's intellectual property is determined to be distinct from the other performance obligations identified in the arrangement, the Company recognizes revenue from consideration allocated to the license when the license is transferred to the licensee and the licensee is able to use and benefit from the license. For licenses that are bundled with other promises, the Company applies judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, to conclude upon the appropriate method of measuring progress for purposes of recognizing revenue related to consideration allocated to the performance obligation.

Research and development services: Arrangements that include a promise for the Company to provide research or development services are assessed to determine whether the services are capable of being distinct, are not highly interdependent or do not significantly modify one another, and if so, the services are accounted for as a separate performance obligation as the services are provided to the customer. Otherwise, when research or development services are determined not to be capable of being distinct, such services are added to the performance obligation that includes the underlying license. For research and development services that are bundled with other promises, the Company applies judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, to conclude upon the appropriate method of measuring progress for purposes of recognizing revenue related to consideration allocated to the performance obligation. The Company evaluates the measure of progress each reporting period and, if necessary, adjusts the measure of performance and related revenue recognition.

Options: Customer options, such as options granted to allow a licensee to choose to research and develop additional product candidates or reserve product candidates against target genes to be identified in the future, or options that allow a customer to designate a target as a lead product, are evaluated at contract inception in order to determine whether those options provide a material right (i.e., an optional good or service offered for free or at a discount) to the customer. If the customer option represents a material right, the material right is treated as a separate performance obligation at the outset of the arrangement. The Company allocates the transaction price to material rights based on the standalone selling price, and revenue is recognized when or as the future goods or services are transferred or when the option expires. Customer options that are not material rights do not give rise to separate performance obligations, and as such, the additional consideration that would result from a customer exercising an option in the future is not included in the transaction price for the current contract. Instead, the option is deemed a marketing offer, and additional option fee payments are recognized or begin being recognized as revenue when the licensee exercises the option. The exercise of an option that does not represent a material right is treated as a separate contract for accounting purposes.

Milestone payments: At the inception of each contract with a customer that includes development or regulatory milestone payments, the Company evaluates whether the milestones are considered probable of being reached and estimates the amount to be included in the transaction price using the most likely amount method. If the Company concludes it is probable that a significant revenue reversal

would not occur, the associated milestone payment is included in the transaction price. Milestone payments that are not within the control of the Company or the licensee, such as regulatory approvals, are generally not considered probable of being achieved until those approvals are received. The transaction price is then allocated to each performance obligation on a relative stand-alone selling price basis, for which the Company recognizes revenue as or when the performance obligations under the contract are satisfied.

At the end of each subsequent reporting period, the Company re-evaluates the probability of achievement of all milestones and any related constraints, and, if necessary, adjusts the estimate of the overall transaction price. Any such adjustments are recorded on a cumulative catch-up basis and are recorded as revenue and through earnings in the period of adjustment.

Royalties: For arrangements that include sales-based royalties, including milestone payments based on the level of sales, and when the license is deemed to be the predominant item to which the royalties relate, the Company recognizes revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied (or partially satisfied).

Contract costs: The Company recognizes as an asset the incremental costs of obtaining a contract with a customer if the costs are expected to be recovered. The Company has elected a practical expedient wherein it recognizes the incremental costs of obtaining a contract as an expense when incurred if the amortization period of the asset that it otherwise would have recognized is one year or less. To date, the Company has not incurred any incremental costs of obtaining a contract with a customer.

Contract modifications: Contract modifications, defined as changes in the scope or price (or both) of a contract that are approved by the parties to the contract, such as a contract amendment, exist when the parties to a contract approve a modification that either creates new or changes existing enforceable rights and obligations of the parties to the contract. Depending on facts and circumstances, the Company accounts for a contract modification as one of the following: (i) a separate contract; (ii) a termination of the existing contract and a creation of a new contract; or (iii) a combination of the preceding treatments. A contract modification is accounted for as a separate contract if the scope of the contract increases because of the addition of promised goods or services that are distinct and the price of the contract increases by an amount of consideration that reflects the Company's standalone selling prices of the additional promised goods or services. When a contract modification is not considered a separate contract and the remaining goods or services are distinct from the goods or services transferred on or before the date of the contract modification, the Company accounts for the contract modification as a termination of the existing contract and a creation of a new contract. When a contract modification is not considered a separate contract and the remaining goods or services are not distinct, the Company accounts for the contract modification as an add-on to the existing contract and as an adjustment to revenue on a cumulative catch-up basis.

The Company receives payments from its licensees as established in each contract. Upfront payments and fees are recorded as deferred revenue upon receipt or when due and may require deferral of revenue recognition to a future period until the Company performs its obligations under these arrangements. Where applicable, amounts are recorded as contracts receivable when the Company's right to consideration is unconditional. The Company does not assess whether a contract with a customer has a significant financing component if the expectation at contract inception is such that the period between payment by the licensees and the transfer of the promised goods or services to the licensees will be one year or less.

Stock-based compensation

The Company's stock-based compensation cost is measured at the grant date of the stock-based award based on the fair value of the award and is recognized as expense over the requisite service period, which generally represents the vesting period, and includes an estimate of the awards that will be forfeited. The Company uses the Black-Scholes valuation model for estimating the fair value of stock options. The fair value of stock option awards is affected by the valuation assumptions, including the expected volatility based on comparable market participants, expected term of the option, risk-free interest rate, and expected dividends.

Income taxes

The Company records deferred tax assets and liabilities for the expected future tax consequences of temporary differences between the Company's financial statement carrying amounts and the tax basis of assets and liabilities using enacted tax rates expected to be in effect in the years in which the differences are expected to reverse. A valuation allowance is provided to reduce the net deferred tax assets to the amount that will more likely than not (more than 50 percent) be realized.

The Company also assesses the probability that the positions taken or expected to be taken in its income tax returns will be sustained by taxing authorities. A "more likely than not" recognition threshold must be met before a tax benefit can be recognized. Tax positions that are more likely than not to be sustained are reflected in the Company's consolidated financial statements. Tax positions are measured as the largest amount of tax benefit that is greater than 50 percent likely of being realized upon settlement with a taxing authority that has full knowledge of all relevant information. The difference between the benefit recognized for a position and the tax benefit claimed on a tax return is referred to as an unrecognized tax benefit. Potential interest and penalties associated with such uncertain tax positions are recorded as a component of income tax expense.

Net loss per common share attributable to common stockholders

The Company computes basic net loss per common share by dividing net loss attributable to common stockholders by the weighted-average number of common shares outstanding. In periods of net income, the Company's accounting policy includes allocating a proportional share of net income to participating securities, as determined by dividing total weighted-average participating securities by the sum of the total weighted-average common shares and participating securities (the "two-class method"). The Company's nonvested restricted shares participated in any dividends declared by the Company and were therefore considered to be participating securities. Participating securities have the effect of diluting both basic and diluted earnings per share during periods of income. During periods when the Company incurred a net loss, the Company did not allocate a loss to participating securities because they had no contractual obligation to share in the losses of the Company. The Company computes diluted net loss per common share after giving consideration to the dilutive effect of stock options, warrants, nonvested restricted stock, and redeemable convertible preferred shares that are outstanding during the period, except where such non-participating securities would be anti-dilutive.

The outstanding securities presented below were excluded from the calculation of net loss per share attributable to common stockholders because such securities would have been anti-dilutive due to the Company's net loss per share attributable to common stockholders during the periods ending on the dates presented.

	DECEMBER 31,		
	2019	2018	2017
Options to purchase common stock	12,467,150	7,787,690	6,124,096
Warrants to purchase common stock	2,198	2,198	87,901
Nonvested restricted common stock	—	—	10,000
Total	12,469,348	7,789,888	6,221,997

Recent accounting pronouncements

The following table provides a description of the recent accounting pronouncements that had a material effect on the Company's consolidated financial statements or disclosures:

Standard	Description	Effective Date for Company	Effect on the Consolidated Financial Statements
Recently Adopted Accounting Standards			
ASU 2014-09, Revenue from Contracts with Customers (Topic 606) and related amendments ("ASC 606")	This ASU amends the guidance for accounting for revenue from contracts with customers, superseding the revenue recognition requirements in ASC 605, *Revenue Recognition*. ASC 606 was effective for annual reporting periods beginning after December 15, 2017. Under ASC 606, two adoption methods were allowed: retrospectively to all prior reporting periods presented, with certain practical expedients permitted, or retrospectively with the cumulative effect of initially adopting ASC 606 recognized at the date of initial application.	January 1, 2018	Effective January 1, 2018, the Company adopted the requirements of ASC 606 using the full retrospective method, which required the Company to recast the prior reporting periods presented. All financial statements and disclosures have been recast to comply with ASC 606. See "Change in accounting principle" below for a summary of the amounts by which each financial statement line item was affected by the adoption of ASC 606. The adoption of ASC 606 has also resulted in additional revenue-related disclosures in the notes to the Company's consolidated financial statements (see Note 8 – Collaborative Research and License Agreements).

Standard	Description	Effective Date for Company	Effect on the Consolidated Financial Statements
ASU 2016-02, Leases (Topic 842)	This ASU supersedes existing accounting standards for lease accounting, including requiring lessees to recognize most leases on their balance sheets and making targeted changes to lessor accounting. ASU 2016-02 requires a modified retrospective transition approach for all leases existing at, or entered into after, the date of initial application, with an option to use certain transition relief. In July 2018, the Financial Accounting Standards Board ("FASB") issued ASU 2018-11, Leases (Topic 842): Targeted Improvements ("ASU 2018-11"), which allows entities to initially apply the new lease guidance at the adoption date and recognize a cumulative-effect adjustment to the opening balance of retained earnings in the period of adoption.	January 1, 2019	The Company adopted ASU 2016-02 on January 1, 2019 and elected the package of three practical expedients that permitted an entity to (a) not reassess whether expired or existing contracts contain leases, (b) not reassess lease classification for existing or expired leases, and (c) not consider whether previously capitalized initial direct costs would be appropriate under the new standard. In addition, the Company has elected to combine lease and non-lease components for certain classes of assets as a single component and not to recognize leases on the balance sheet with an initial term of one year or less. Upon adoption, the Company recorded ROU assets of $2.7 million and lease liabilities of $2.8 million. Comparative periods prior to adoption have not been retrospectively adjusted. Initial implementation of the standard did not have a material impact on the statement of operations or statement of cash flows.

Change in accounting principle

In May 2014, the FASB issued ASC 606. Under the standard, revenue is recognized when a customer obtains control of promised goods or services in an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services. Effective January 1, 2018, the Company adopted ASC 606 using the full retrospective method, which required the Company to recast the prior reporting periods presented.

The Company recast its consolidated financial statements from amounts previously reported due to the adoption of ASC 606. Select Consolidated Statement of Operations line items, which reflect the impact of the adoption of ASC 606, are as follows:

	YEAR ENDED DECEMBER 31, 2017		
	AS REPORTED	ADJUSTMENTS	AS ADJUSTED
Revenue arrangements	$ 1,182	$ (152)	$ 1,030
Loss from operations	$ (60,587)	$ (152)	$ (60,739)
Net loss	$ (60,048)	$ (152)	$ (60,200)
Net loss attributable to common stockholders	$ (80,140)	$ (152)	$ (80,292)

The adoption of ASC 606 did not have an impact on net loss per share attributable to common stockholders for any period presented.

Select Consolidated Balance Sheet line items, which reflect the adoption of ASC 606, are as follows:

	DECEMBER 31, 2017		
	AS REPORTED	ADJUSTMENTS	AS ADJUSTED
Prepaid expenses and other current assets	$ 3,297	$ 118	$ 3,415
Current portion of deferred revenue	$ 6,000	$ 180	$ 6,180
Deferred revenue, net of current portion	$ 3,000	$ 90	$ 3,090
Accumulated deficit	$ (315,804)	$ (152)	$ (315,956)

The adoption of ASC 606 did not have an impact on net cash used in operating, investing, or financing activities in the Company's Consolidated Statements of Cash Flows.

3. HELD-TO-MATURITY INVESTMENTS

The following tables provide information relating to the Company's held-to-maturity investments:

	DECEMBER 31, 2019			
DESCRIPTION	AMORTIZED COST	GROSS UNREALIZED HOLDING GAINS	GROSS UNREALIZED HOLDING LOSSES	FAIR VALUE
U.S. Treasury securities maturing in one year or less	$ 196,065	$ 160	$ (6)	$ 196,219

	DECEMBER 31, 2018			
DESCRIPTION	AMORTIZED COST	GROSS UNREALIZED HOLDING GAINS	GROSS UNREALIZED HOLDING LOSSES	FAIR VALUE
U.S. Treasury securities maturing in one year or less	$ 248,387	$ —	$ (43)	$ 248,344

4. FAIR VALUE MEASUREMENTS

A summary of the Company's assets that are measured or disclosed at fair value on a recurring basis is presented below:

	DECEMBER 31, 2019			
DESCRIPTION	TOTAL FAIR VALUE	LEVEL 1	LEVEL 2	LEVEL 3
Cash equivalents				
Money market funds	$ 152,903	$ 152,903	$ —	$ —
Held-to-maturity investments				
U.S. Treasury securities	196,219	—	196,219	—
Restricted cash equivalents				
Money market funds	3,894	3,894	—	—
Total	$ 353,016	$ 156,797	$ 196,219	$ —

	DECEMBER 31, 2018			
DESCRIPTION	TOTAL FAIR VALUE	LEVEL 1	LEVEL 2	LEVEL 3
Cash equivalents				
Money market funds	$ 44,886	$ 44,886	$ —	$ —
Held-to-maturity investments				
U.S. Treasury securities	248,344	—	248,344	—
Restricted cash equivalents				
Money market funds	744	—	744	—
Total	$ 293,974	$ 44,886	$ 249,088	$ —

The Company's cash equivalents and restricted cash equivalents, which are in money market funds, are classified within Level 1 of the fair value hierarchy because they are valued using quoted prices in active markets as of December 31, 2019 and 2018.

The Company's held-to-maturity investments bore interest at the prevailing market rates for instruments with similar characteristics and therefore approximated fair value. These financial instruments were classified within Level 2 of the fair value hierarchy, because the inputs to the fair value measurement are valued using observable inputs as of December 31, 2019 and 2018. The Company's policy is to recognize transfers between levels of the fair value hierarchy, if any, at the end of the reporting period; however, there have been no such transfers during any of the periods presented.

As of December 31, 2019 and 2018, the Company's contract receivables, accounts payable, and accrued expenses approximated their estimated fair values because of the short-term nature of these financial instruments.

The litigation settlement payable at December 31, 2018 represents the remaining cash obligation payable to Alnylam (see Note 15) under the terms of the Settlement & Release Agreement executed between the parties on April 28, 2018 ("Settlement Agreement"). The litigation settlement payable was recorded as the present value of the future cash payments to be made by the Company under the terms of the Settlement Agreement. As the present value of the litigation settlement payable was determined using market rates based on the nature of the obligation and the Company's creditworthiness, the carrying value approximates the fair value.

5. PREPAID EXPENSES AND OTHER CURRENT ASSETS

Prepaid expenses and other current assets consist of the following:

	DECEMBER 31,	
	2019	2018
Prepaid clinical, contract research, and manufacturing costs	$ 4,288	$ 1,419
Interest receivable and other current assets	1,733	815
Prepaid insurance	583	341
Prepaid rent	—	245
Other	330	68
Prepaid expenses and other current assets	$ 6,934	$ 2,888

6. PROPERTY AND EQUIPMENT, NET

Property and equipment, net, consists of the following:

	DECEMBER 31,	
	2019	2018
Laboratory equipment	$ 9,147	$ 4,607
Office and computer equipment	2,425	1,021
Furniture and fixtures	1,569	479
Leasehold improvements	257	257
Construction-in-process	238	1,661
Property and equipment, at cost	13,636	8,025
Less: accumulated depreciation and amortization expense	(6,560)	(5,307)
Property and equipment, net	$ 7,076	$ 2,718

Depreciation and amortization expense was $1.3 million, $0.8 million and $0.8 million for the years ended December 31, 2019, 2018, and 2017.

7. ACCRUED EXPENSES AND OTHER CURRENT LIABILITIES

Accrued expenses and other current liabilities consist of the following:

	DECEMBER 31,	
	2019	2018
Accrued clinical, contract research, and manufacturing costs	$ 10,347	$ 3,960
Accrued compensation and other employee-related benefits	7,298	3,684
Accrued professional fees	1,519	1,693
Other accrued expenses and current liabilities	878	312
Accrued expenses and other current liabilities	$ 20,042	$ 9,649

8. COLLABORATIVE RESEARCH AND LICENSE AGREEMENTS

Novo collaboration and share purchase agreements

Background

On November 15, 2019, Dicerna and Novo entered into a Collaboration and License Agreement (the "Novo Collaboration Agreement"). Under the terms of the Novo Collaboration Agreement, the Company and Novo will seek to use the Company's proprietary GalXC™ RNAi platform ("GalXC™") technology to progress novel therapies for the treatment of liver-related cardiometabolic diseases towards clinical development and commercialization.

Under the Novo Collaboration Agreement, the Company and Novo plan to explore more than 30 gene targets associated with liver disease with the goal of delivering multiple clinical candidates for disorders including chronic liver disease, non-alcoholic steatohepatitis ("NASH"), type 2 diabetes, obesity, and rare diseases. The Company will conduct and fund discovery and preclinical development to clinical candidate selection for each liver cell target. Novo will be responsible for all further development and commercialization of each candidate selected for development, with the Company manufacturing clinical candidates selected for Phase 1 related clinical development, subject to reimbursement for its manufacturing costs. In addition, the Company will assist Roche with the Investigational New Drug ("IND") filing for the first development candidate. The Company also retains the ability to opt in to co-development of a total of two programs during clinical development in Phases 1-3, subject to limitations in the event of a change in control. If the Company exercises the co-development option, it also has an option to co-promote the products in the United States, subject to limitations in the event of a change in control of the Company. Additionally, the Company may lead the development and commercialization of two programs targeting orphan liver diseases, with Novo retaining the ability to opt in to both programs in Phases 1-3. The Company and Novo will share profit and loss for the Company's orphan liver and Novo products should both parties elect to co-develop.

The Novo Collaboration Agreement provides that the Company will work exclusively with Novo during the research collaboration period on the discovery, research, development, and commercialization of hepatocyte targets not otherwise subject to the Company's existing partnerships and that Novo will, during a specified discovery period, work exclusively with the Company in any new research and development of compounds and products directed to collaboration targets using small interfering RNA ("siRNA") conjugated to the sugar *N*-acetyl-D-galactosamine ("GalNAc") to reduce the expression of specific target genes in the liver. Under the Novo Collaboration Agreement, the Company will provide Novo with exclusive and non-exclusive licenses and manufacturing support to enable Novo to commercialize products derived from or containing compounds developed pursuant to such agreement.

Under the terms of the Novo Collaboration Agreement, Novo paid the Company an upfront payment of $175.0 million, subject to delivery of target information, in January 2020. The Company is also eligible to receive an additional $75.0 million ($25.0 million at the end of each of the first three years of the Novo Collaboration Agreement), contingent upon the Company delivering GalXC™ molecules for a defined number of targets, and additional payments totaling up to approximately $357.5 million per target upon achievement of specified development, regulatory, and commercial milestones. In addition, the Novo Collaboration Agreement provides that Novo will pay to the Company up to mid-single-digits to mid-teens royalties on product sales on a country by-country and product-by-product basis until the later of 10 years after the date of first commercial sale of each product in such country, expiration of specified patent rights in such country, or the expiration of specified regulatory exclusivity in such country for GalXC products, subject to royalty step-down provisions set forth in the agreement.

In connection with the Novo Collaboration Agreement, the Company and Novo entered into the Novo Share Issuance Agreement on November 15, 2019, pursuant to which the Company agreed to issue to Novo 2,279,982 shares (the "Novo Shares") of the Company's common stock, par value $0.0001 per share ("Common Stock"), at a purchase price of $21.93 per share, for an aggregate purchase price of approximately $50.0 million.

Accounting Analysis

The Novo Collaboration Agreement and the Novo Share Issuance Agreement (collectively, "the Novo Agreements") were executed on the same date and negotiated as a package. Management therefore concluded that the Novo Agreements are to be combined for accounting purposes and concluded that Novo is a customer in this arrangement pursuant to the guidance under ASC 606.

The Company identified contract promises under the agreement for the license of intellectual property and know-how rights for selected gene targets and research and development services to develop a clinical candidate for each selected gene target, including manufacturing activities. The Company may also be required to provide research and development services for an unspecified number of targets, with the goal of the collaboration being to develop clinical candidates for each of the selected gene targets. The Company determined that the license and research and development services were not capable of being distinct or distinct within the context of the contract. The research and development services to be provided by Dicerna are specialized in nature, specifically with respect to the Company's therapeutic expertise related to RNAi and the Company's GalXC conjugates. In addition, there is an interdependent

relationship between the contract promises. As such, the Company concluded that there is a single identified combined performance obligation consisting of a license and research and development services.

The Company may be required to perform certain additional services after Novo's nomination of a development candidate. These services include manufacturing activities through the approval of an IND application for a development candidate, research and development activities to support the filing of an IND application for the first development candidate, and other development services to support Novo's development activities related to any development candidates. The Company will be reimbursed by Novo for these additional services. Because the provision of these additional goods and services are conditional on Novo electing to nominate a development candidate, the Company has concluded that these goods and services represent customer options and are not considered performance obligations.

The total transaction price for the Novo Agreements is $254.2 million, consisting of the total $175.0 million upfront compensation, $75.0 million (payable in three equal annual payments of $25.0 million), and a $4.2 million premium on the sale of shares under the Novo Share Issuance Agreement. The Company applied equity accounting guidance to measure the $45.8 million recorded in equity upon the issuance of the shares. The upfront payment of $175.0 million was payable to the Company upon the delivery of a bioinformatics package and mapping plan for at least one of the initial targets selected by Novo, and therefore, the Company has concluded that such payment represents variable consideration. The Company views the delivery of the bioinformatics package and mapping plan as akin to achieving a milestone. Because the Company has experience with providing bioinformatics and mapping information, it concluded that such amount does not need to be constrained and has included the $175.0 million in the transaction price. The $75.0 million in additional payments is contingent on the Company providing a certain number of mapped targets per year. If the Novo Collaboration Agreement is terminated prior to the third anniversary of its effective date, the Company is entitled to 80% of the outstanding and unearned annual payments. Pursuant to ASC 606, for the purpose of determining the transaction price, the Company assumed that the mapped targets will be delivered and that the contract will not be canceled. The Company also has experience with mapping targets, and therefore, concluded that such amount does not need to be constrained. Accordingly, the Company will include the $75.0 million of additional payments in the transaction price.

The Company used the most likely amount method to estimate variable consideration and estimated that the most likely amount for each potential preclinical, development, and regulatory milestone payment under this agreement, which is considered variable consideration, was zero, as the achievement of those milestones is uncertain and highly susceptible to factors outside of the Company's control. Accordingly, all such milestones were excluded from the transaction price. Management will re-evaluate the transaction price at the end of each reporting period, and as uncertain events are resolved or other changes in circumstances occur, and adjust the transaction price as necessary. Sales-based royalties, including milestone payments based on the level of sales, were also excluded from the transaction price, as the license is deemed to be the predominant item to which the royalties relate. The Company will recognize such revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied (or partially satisfied).

Revenue associated with the performance obligation will be recognized as services are provided using a cost-to-cost measure of progress method. The transfer of control occurs over time, as the Company's performance does not create an asset with alternative use, and the Company has an enforceable right to payment for performance completed to date. In management's judgment, this input method is the best measure of progress towards satisfying the performance obligation and reflects a faithful depiction of the transfer of goods and services.

No revenue was recognized under the Novo Collaboration Agreement during the year ended December 31, 2019. The Company was required to deliver a bioinformatics package and mapping plan to Novo prior to receiving payment of the $175.0 million upfront payment. The Company commenced and completed delivery of the bioinformatics package in January 2020. Therefore, no contract asset or contract liability related to the $175.0 million upfront payment was recorded as of December 31, 2019. The aggregate amount of the equity transaction that was allocated to the revenue element of the arrangement as of December 31, 2019 relates to the Company's wholly unsatisfied performance obligation, and is recorded as a contract liability presented in deferred revenue at December 31, 2019. Of the $4.2 million recorded in deferred revenue, $0.8 million is included in the current portion of deferred revenue. As of December 31, 2019, the Company expected to recognize revenue over the five-year research term, which may be extended for up to two years.

Roche collaboration agreement

Background

On October 30, 2019, the Company and Roche entered into a Collaboration and License Agreement (the "Roche Collaboration Agreement"). Under the terms of the Roche Collaboration Agreement, the Company and Roche will seek to progress RG6346 (formerly DCR-HBVS), the Company's investigational therapy in Phase 1 clinical development, toward worldwide development and

commercialization as well as provide an option for the companies to collaborate in the discovery, development, and commercialization of oligonucleotide therapeutics intended for the treatment of hepatitis B virus ("HBV").

The Roche Collaboration Agreement requires that Dicerna completes the ongoing Phase 1 clinical trial, along with additional Phase 1 cohorts that were requested by Roche, who will reimburse the Company for the cost of the additional cohorts, after which Roche will lead the development and commercialization of the RG6346 program. Roche also has until receipt of interim Phase 1 data from the RG6346 Phase 1 study (but no later than December 31, 2020) to initiate a research and development collaboration with the Company to pursue up to five targets selected by Roche which are intended primarily to treat HBV. Under the terms of the Roche Collaboration Agreement, the goal of such research and development collaboration will be to select compounds developed by the Company or Roche for Roche's continued development and commercialization. The Roche Collaboration Agreement provides that the Company and Roche's research and early development organization will work exclusively with each other during the research and development collaboration period on the discovery, research, and development of such targets selected by Roche, which includes the performance of certain services by Dicerna. Under the Roche Collaboration Agreement, the Company will provide Roche with exclusive and non-exclusive licenses to support Roche's activities and to enable Roche to commercialize products derived from or containing compounds developed pursuant to such agreement.

Under the terms of the Roche Collaboration Agreement, Roche paid the Company a non-refundable upfront payment of $200.0 million in January 2020. The Company is also eligible to receive additional payments totaling up to approximately $1.47 billion, which includes payments upon achievement of specified development, regulatory, and commercial milestones. In addition, the Roche Collaboration Agreement provides that Roche will pay to the Company up to mid-teens percent royalties on product sales. Royalties are payable until the later of 10 years after first commercial sale of each product in a country, expiration of patent rights in a country, or for products containing RG6346 in a given country, the expiration of data or regulatory exclusivity, subject to certain royalty step-down provisions set forth in the agreement. In addition, the Company has an option to co-fund the development of products under the agreement and, if exercised, receive high twenties to mid-thirties royalty rates on the net sales of products in the United States. If the Company exercises the co-funding option, it shall also have an option to co-promote products containing RG6346 in the United States.

Accounting Analysis

The Company concluded that Roche is a customer in this arrangement pursuant to the guidance under ASC 606. The Company identified contract promises under the agreement for (i) the license of intellectual property and know-how rights related to the lead compound, (ii) research and development services to complete the Phase 1 study associated with the lead compound, (iii) lead compound transfer activities, (iv) manufacturing of clinical supply for the lead compound Phase 1 study, and (v) Roche's option to receive additional goods and services related to the research and development collaboration. The Company determined that the Roche Collaboration Agreement contains two performance obligations consisting of: (i) a combined performance obligation that includes a license, related development and manufacturing services to complete the Phase 1 study, and manufacturing obligations through the completion of the Phase 1 study related to the lead compound, and (ii) a material right to enter into a research and development collaboration to develop additional targets. While evaluating contract promises to determine whether each was capable of being distinct and distinct within the context of the contract, management considered the specialized nature of the services to be provided by Dicerna, specifically with respect to the Company's therapeutic expertise related to RNAi and the Company's GalXC conjugates, and the interdependent relationship between the contract promises. As such, the Company concluded that the promises of the license and research and development services related to the lead compound were not distinct from each other. Accordingly, these promises were combined into one performance obligation. Upon Roche's exercise of its option to enter into the research and development collaboration for which no additional consideration will be received, Roche has the right to nominate up to five additional targets. To enter the research and development collaboration, Roche is required to nominate three targets (each, a "Selected Target") prior to December 31, 2020. For each target, Roche will receive a license to the Selected Target, for which the Company will perform research services through clinical candidate selection. The Company is not required to perform services on more than three Selected Targets at any time. Roche also has the right to replace up to three Selected Targets if a clinical candidate cannot be identified during the research term.

The total transaction price for the Roche Collaboration Agreement is $204.5 million, consisting of the upfront payment of $200.0 million and the estimated reimbursement from Roche related to the additional cohorts. The Company used the most likely amount method to estimate the amount of reimbursement, which was considered variable consideration, from Roche related to the additional cohorts. As reimbursement will be made as the Company performs the related services, the Company concluded that such amount does not need to be constrained, and therefore, included the full amount of the estimated reimbursement by Roche in the transaction price.

The Company also estimated that the most likely amount for each potential development and regulatory milestone payment under this agreement, which was considered variable consideration, was zero, as the achievement of those milestones is uncertain and highly susceptible to factors outside of the Company's control. Accordingly, all such milestones were excluded from the transaction price.

Management will re-evaluate the transaction price at the end of each reporting period, and as uncertain events are resolved or other changes in circumstances occur, and adjust the transaction price as necessary. Sales-based royalties, including milestone payments based on the level of sales, were also excluded from the transaction price, as the license is deemed to be the predominant item to which the royalties relate. The Company will recognize such revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied (or partially satisfied).

The Company allocated the fixed consideration of $204.5 million included in the transaction price to the performance obligations on a relative standalone selling price basis. The Company estimated the standalone selling price for the lead compound performance obligation using the adjusted market assessment approach, whereby the Company adjusted comparable third-party transactions to reflect the stage of development of the Company's asset. To determine the estimated standalone selling price of the material right, the Company estimated the standalone selling price of the underlying performance obligations included in the material right and estimated the probability of Roche exercising such underlying performance obligations. The Company concluded that the research and development collaboration material right contains (i) five material rights to receive a Selected Target license and related research and development services, and (ii) three material rights to receive a replacement Selected Target license and related research and development services. The variable consideration related to the reimbursement from Roche for the additional Phase 1 cohorts and any milestones and royalties that are achieved will be allocated specifically to the lead compound performance obligation, as this variable consideration relates specifically to the Company's satisfaction of the lead compound performance obligation and such allocation has been determined to be consistent with the allocation objective of ASC 606.

Revenue associated with the lead compound performance obligation will be recognized as services are provided using a cost-to-cost measure of progress method. The transfer of control occurs over time, as the Company's performance does not create an asset with alternative use, and the Company has an enforceable right to payment for performance completed to date. In management's judgment, this input method is the best measure of progress towards satisfying the performance obligation and reflects a faithful depiction of the transfer of goods and services. The transaction price allocated to the research and development collaboration material right will be recognized based on the timing of recognition of the underlying performance obligations that comprise the material right, or upon expiry of the material right if such right is not exercised.

No revenue was recognized under the Roche Collaboration Agreement during the year ended December 31, 2019, as activities under the arrangement had not yet commenced. The aggregate amount of the consideration received and the amount billed under the arrangement that were allocated to the revenue element of the arrangement as of December 31, 2019 relates to the Company's wholly unsatisfied performance obligation. At December 31, 2019, this $200.0 million amount is recorded as a contract liability presented in deferred revenue, of which $118.1 million is included in the current portion of deferred revenue and is primarily associated with completion of our Phase 1 study of RG6346. As of December 31, 2019, the Company expected to recognize the balance of deferred revenue during the estimated three-year research term, which may be extended for up to two years.

Lilly collaboration and share purchase agreements

Background

On October 25, 2018, the Company entered into a Collaboration and License Agreement (the "Lilly Collaboration Agreement") with Lilly for the discovery, development, and commercialization of potential new medicines in the areas of cardiometabolic disease, neurodegeneration, and pain. Under the terms of the Lilly Collaboration Agreement, the Company and Lilly will seek to use the Company's proprietary GalXC RNAi technology platform (the "GalXC platform") to progress new drug targets toward clinical development and commercialization. In addition, the Company and Lilly will collaborate to extend the GalXC platform technology to non-liver (i.e., non-hepatocyte) tissues, including neural tissues.

The Lilly Collaboration Agreement provides that the Company will work exclusively with Lilly in the neurodegeneration and pain fields, with the exception of mutually agreed upon orphan indications. Additionally, the Company will work exclusively with Lilly on select targets in the cardiometabolic field. Under the Lilly Collaboration Agreement, the Company will provide Lilly with exclusive and non-exclusive licenses to support the companies' activities and to enable Lilly to commercialize products derived from or containing compounds developed pursuant to such agreement. The Lilly Collaboration Agreement provides for three initially named hepatocyte targets, and the Company and Lilly have agreed to develop an initial research program with the goal of researching and developing multiple lead candidates directed to each of these initial targets. The Lilly Collaboration Agreement contemplates in excess of 10 targets.

Under the terms of the Lilly Collaboration Agreement, Lilly agreed to pay the Company a non-refundable upfront payment of $100.0 million. The Company is also eligible to receive up to $350.0 million per target in development and commercialization milestones, in addition to a $5.0 million payment, which will become due for each of the non-hepatocyte targets when a product candidate achieves proof of principle in an animal model. In addition, the Company is eligible to earn mid-single to low-double digit royalties on product sales on a country-by-country and product-by-product basis until the later of expiration of patent rights in a country, the expiration of

data or regulatory exclusivity in such country, or 10 years after the first product sale in such country, subject to certain royalty step-down provisions set forth in the agreement. Simultaneously with the entry into the Lilly Collaboration Agreement, the Company and Lilly entered into a Share Purchase Agreement (the "Lilly Share Issuance Agreement"), pursuant to which Lilly purchased 5,414,185 shares of the Company's common stock at $18.47 per share, for an aggregate purchase price of $100.0 million. Management concluded that the Lilly Share Issuance Agreement is to be combined with the Lilly Collaboration Agreement (together, the "Combined Agreements") for accounting purposes. Of the total $200.0 million upfront compensation, the Company applied equity accounting guidance to measure the $51.3 million recorded in equity upon the issuance of the shares, and $148.7 million was identified as the transaction price allocated to the revenue arrangement.

Accounting Analysis

The Company concluded that Lilly is a customer in this arrangement, and as such, the element of the arrangement unrelated to the issuance of the shares falls within the scope of the revenue recognition guidance. The Company identified contract promises under the Combined Agreements for licenses of intellectual property and know-how rights, associated research and development services for targets and for the extension of the GalXC platform, and participation on a joint steering committee. The Company determined that the contract promises were not separately identifiable and were not distinct or distinct within the context of the contract due to the specialized nature of the services to be provided by Dicerna, specifically with respect to the Company's therapeutic expertise related to RNAi and the Company's GalXC conjugates, and the interdependent relationship between the contract promises. As such, the Company concluded that there was a single identified combined performance obligation.

The Company used the most likely amount method to estimate variable consideration and estimated that the most likely amount for each potential development milestone payment under this agreement, which is considered variable consideration, was zero, as the achievement of those milestones is uncertain and highly susceptible to factors outside of the Company's control. Accordingly, all such milestones were excluded from the transaction price. Management will re-evaluate the transaction price at the end of each reporting period, and as uncertain events are resolved or other changes in circumstances occur, and adjust the transaction price as necessary. Sales-based royalties, including milestone payments based on the level of sales, were also excluded from the transaction price, as the license is deemed to be the predominant item to which the royalties relate. The Company will recognize such revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied (or partially satisfied).

Revenue associated with the performance obligation will be recognized as services are provided using a cost-to-cost measure of progress method. The transfer of control occurs over time and, in management's judgment, this input method is the best measure of progress towards satisfying the performance obligation and reflects a faithful depiction of the transfer of goods and services.

The Company began recognizing revenue under the Lilly Collaboration Agreement during the year ended December 31, 2019, of which $13.1 million had been recognized to the accompanying consolidated statement of operations. The amount of the Company's partially unsatisfied performance obligation, recorded as a contract liability presented in deferred revenue at December 31, 2019 and 2018, is $135.5 million and $148.7 million, respectively, of which $63.2 million and $54.0 million, respectively, is included in the current portion of deferred revenue. As of December 31, 2019, the Company expected to recognize this amount over the remaining research term of the agreement, which is expected to extend through the second quarter of 2022.

Alexion collaboration and share purchase agreements

Background

On October 22, 2018, the Company and Alexion entered into a Collaborative Research and License Agreement (the "Alexion Collaboration Agreement"). The Alexion Collaboration Agreement is for the joint discovery and development of RNAi therapies for complement-mediated diseases. Under the terms of the Alexion Collaboration Agreement, the Company and Alexion will collaborate on the discovery and development of subcutaneously delivered GalXC candidates, currently in preclinical development, for the treatment of complement-mediated diseases with potential global commercialization by Alexion. The Company will lead the joint discovery and research efforts through the preclinical stage, and Alexion will lead development efforts beginning with Phase 1 studies. The Company will be responsible for manufacturing the GalXC candidates through the completion of Phase 1, and certain related costs will be paid by Alexion. Alexion will be solely responsible for the manufacturing of any product candidate subsequent to the completion of Phase 1. The Alexion Collaboration Agreement provides Alexion with exclusive worldwide licenses as well as development and commercial rights to the GalXC RNAi molecules developed in the collaboration in exchange for development- and approval-related milestones, sales milestones, and mid-single to low-double digit royalties on future product sales.

Under the terms of the Alexion Collaboration Agreement, Alexion agreed to pay the Company a non-refundable upfront payment of $22.0 million. The Alexion Collaboration Agreement also provides for potential additional payments to the Company of up to $600.0

million from proceeds from target option exercises and development and sales milestones, as defined in the agreement, which includes: (i) option exercise fees of up to $20.0 million, representing $10.0 million for each of the targets selected; (ii) development milestones of up to $105.0 million for each product; and (iii) aggregate sales milestones of up to $160.0 million. Under the agreement, Alexion also agreed to pay to the Company mid-single to low-double digit royalties on potential product sales on a country-by-country, product-by-product basis until the later of the expiration of patent rights in a country, the expiration of market or regulatory exclusivity in such country, or 10 years after the first product sale in such country, subject to certain royalty step-down provisions set forth in the agreement.

Simultaneously with the entry into the Alexion Collaboration Agreement, the Company and Alexion Pharmaceuticals entered into a Share Purchase Agreement (the "Alexion Share Issuance Agreement"), pursuant to which Alexion Pharmaceuticals purchased 835,834 shares of the Company's common stock at $17.95 per share at issuance, for an aggregate purchase price of $15.0 million. Management concluded that the Alexion Share Issuance Agreement is to be combined with the Alexion Collaboration Agreement (together, the "Alexion Agreements") for accounting purposes. With respect to the $15.0 million of cash received upon issuance of the shares, the Company applied equity accounting guidance to measure the $9.1 million recorded in equity upon the issuance of the shares, and the remaining $5.9 million was included as a component of the transaction price attributable to the revenue arrangement.

Accounting Analysis

The Company concluded that Alexion is a customer in this arrangement, and as such, the element of the arrangement unrelated to the issuance of the shares falls within the scope of the revenue recognition guidance. The Company identified the following promises under the arrangement: (i) the grant of licenses of intellectual property and know-how rights; (ii) the option to select additional targets; (iii) the option to perform validation testing on additional targets; (iv) associated research and development services for the initial and, as applicable, additional targets; and (v) participation in the joint steering committee. The Company concluded that the research and development services were not capable of being distinct from the research and development licenses, and were not distinct within the context of the contract, and should therefore be combined into a single performance obligation for each program. The Company considered the level of Alexion's therapeutic expertise specifically related to RNAi, as well as Alexion's know-how of the Company's GalXC conjugates, and concluded that Alexion cannot currently benefit from the granted license on its own or together with other resources that are readily available to Alexion, including relationships with oligonucleotide vendors who synthesize GalXC conjugates under contract with the Company. The Company also concluded that, while participation on the joint steering committee was capable of being distinct, participation is not distinct from the research and development services within the context of the contract, as they are both inputs to the combined output of a target that successfully achieves IND approval. This is highlighted as an indicator in Accounting Standards Codification ("ASC") 606, Contracts with Customers, that a significant integration service is being provided. As a result, the combination of the license of intellectual property together with the provision of research and development services and participation on the joint steering committee together represent the highest level of goods and services that can be deemed distinct.

Additionally, the Company determined that the options to select additional targets and to perform validation testing on additional targets were not priced at a discount and, as such, do not provide Alexion with material rights. Based on management's assessments, the Company identified a single performance obligation, namely, the combined license and research and development services, for each of the two initially nominated targets.

At the outset of the Alexion Collaboration Agreement, the transaction price was determined to be $37.4 million, which is comprised of the $22.0 million upfront payment, the $5.9 million identified upon issuance of the shares, as described above, and $9.5 million in aggregate contingent milestone payments that were either received or probable of achievement and under the Company's control.

The Company used the most likely amount method to estimate variable consideration and estimated that the most likely amount for each potential development milestone payment beyond the three initial research program milestones under this agreement was zero, as the achievement of those milestones is uncertain and highly susceptible to factors outside of the Company's control. Accordingly, such milestones were excluded from the transaction price. Management will re-evaluate the transaction price at the end of each reporting period, and as uncertain events are resolved or other changes in circumstances occur, and adjust the transaction price as necessary. Sales-based royalties, including milestone payments based on the level of sales, were also excluded from the transaction price, as the license is deemed to be the predominant item to which the royalties relate. The Company will recognize such revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied (or partially satisfied).

Revenue associated with the performance obligations is being recognized as services are provided using an input method based on a cost-to-cost measure of progress. The transfer of control occurs over time and, in management's judgment, this input method is the best measure of progress towards satisfying the performance obligation and reflects a faithful depiction of the transfer of goods and services.

In November 2019, the Company and Alexion amended the Alexion Collaboration Agreement (the "Amendment") to clarify funding of certain manufacturing costs for each of the two initial targets and increased milestone payments for the additional targets if Alexion exercised its options for the two additional targets.

In December 2019, Alexion exercised its options for the exclusive rights to two additional targets within the complement pathway for the discovery and development of GalXC™ RNAi molecules. These exercises expand the companies' existing research collaboration and license agreement to now encompass four targets within the complement pathway. In connection with the option exercises, Alexion paid Dicerna a total of $20.0 million, or $10.0 million in option exercise fees per additional new target that will be recognized into revenue as the related services are performed.

The Company concluded that the Amendment modified the original agreement, as the transaction price was changed as a result of Dicerna assuming responsibility for certain manufacturing costs associated with the initial targets. The exercise of the options created a single new arrangement for accounting purposes.

The Company concluded that Alexion is a customer in the Amendment. The Company identified the following promises under the Amendment: (i) the grant of licenses of intellectual property and know-how rights, and (ii) associated research and development services for the additional targets. The Company concluded that the research and development services were not capable of being distinct from the research and development licenses, and were not distinct within the context of the contract, and should therefore be combined into a single performance obligation for each program. Similar to the initial targets, the Company considered the level of Alexion's therapeutic expertise specifically related to RNAi, as well as Alexion's know-how of the Company's GalXC conjugates, and concluded that Alexion cannot currently benefit from the granted license on its own or together with other resources that are readily available to Alexion. As a result, the combination of the license of intellectual property together with the provision of research and development services together represent the highest level of goods and services that can be deemed distinct. Based on management's assessments, the Company identified a single performance obligation, namely, the combined license and research and development services, for each of the two additional targets. At the outset of the Amendment, the transaction price was determined to be $35.0 million, which is comprised of the $20.0 million in option exercise fees and $15.0 million in aggregate contingent milestone payments that were probable of achievement and under the Company's control.

The Company began recognizing revenue under the Alexion Agreements during the year ended December 31, 2018. During the years ended December 31, 2019 and 2018 the Company had recognized $4.4 million and $0.1 million, respectively, as revenue in the accompanying consolidated statement of operations. The aggregate amount of the transaction price allocated to the Company's partially unsatisfied performance obligations and recorded as deferred revenue at December 31, 2019 and 2018 is $53.0 million and $31.3 million, of which $27.9 million and $11.7 million, respectively, is included in current portion of deferred revenue. As of December 31, 2019, the Company expects the majority of deferred revenue to be recognized through the fourth quarter of 2021.

BI Agreement and related amendments

Background

On October 27, 2017, the Company entered into a collaborative research and license agreement with BI (the "BI Agreement"), pursuant to which the Company and BI jointly research and develop product candidates for the treatment of chronic liver disease using the GalXC platform, Dicerna's proprietary RNAi-based technology. The BI Agreement is for the development of product candidates against one target gene with an option for BI to add the development of product candidates that target a second gene (the "Second Target"). Pursuant to the BI Agreement, Dicerna granted BI a worldwide license in connection with the research and development of such product candidates and transferred certain intellectual property rights of the selected product candidates to BI for clinical development and commercialization. Dicerna also may provide assistance to BI in order to help BI further develop selected product candidates. Under the terms of the BI Agreement, BI agreed to pay Dicerna a non-refundable upfront payment of $10.0 million for the first target, less a refundable withholding tax in Germany of $1.6 million. BI also agreed to reimburse Dicerna certain third-party expenses of $0.3 million. The German withholding tax was withheld by BI and remitted to the German tax authorities in accordance with local tax law. The Company received reimbursement of this tax in July 2018.

The Company is eligible to receive up to $191.0 million in potential development and commercial milestones related to the initial target. Dicerna is also eligible to receive royalty payments on potential global net sales, subject to certain adjustments, tiered from high single digits up to low double-digits. BI's Second Target option provides for an option fee payment of $5.0 million and success-based development and commercialization milestones and royalty payments to Dicerna.

Milestone payments that are contingent upon the Company's performance under the BI Agreement include potential developmental milestones totaling $99.0 million. The Company has excluded these amounts from allocable consideration at the outset of the arrangement, as described below. All potential net sales milestones, totaling $95.0 million, will be accounted for in the same manner as royalties and recorded as revenue at the later of the achievement of the milestone or the satisfaction of the performance obligation.

Accounting Analysis

The Company concluded that BI is a customer in this arrangement, and as such, the arrangement falls within the scope of the revenue recognition guidance. The Company identified the following promises under the contract: the license of intellectual property and conducting agreed-upon research program services. The Company concluded that the license and research and development services are not capable of being distinct and are not distinct within the context of the contract; therefore, the Company considers these to be one performance obligation. The Company concluded that the option underlying the transfer of future licenses and potential associated research for any not-yet-known target gene is not a performance obligation of the contract at inception because the option fee reflects the standalone selling price of the option, and therefore, the option is not considered to be a material right. The Company considered the level of BI's therapeutic expertise specifically related to RNAi, as well as BI's know-how with regard to the Company's GalXC conjugates, and concluded that BI cannot currently benefit from the granted license on its own or together with other resources that are readily available to BI, including relationships with oligonucleotide vendors who synthesize GalXC conjugates under contract with the Company. As a result, the combination of the license of intellectual property together with the provision of research and development support services together represent the highest level of goods and services that can be deemed distinct.

Based on management's evaluation, the $10.0 million non-refundable upfront fee and the $0.3 million agreed-upon reimbursable third-party expenses constituted the amount of the consideration to be included in the transaction price and were allocated to the performance obligation identified. None of the development milestones have been included in the transaction price during the period, since none of such milestone amounts are within the control of the Company and are not considered probable to occur until confirmed by BI, at BI's sole discretion. Any consideration related to commercial sales-based milestones (including royalties) will be recognized when the related sales occur, since these amounts have been determined to relate predominantly to the license granted to BI and therefore are recognized at the later of when the performance obligation is satisfied or when the related sales occur.

The $10.3 million transaction price for the first target was recognized through July 2019, which was the point where the Company's obligation to provide research support services to BI for the first target ended. Related revenue was recognized on a straight-line basis, which was, in management's judgment, an appropriate measure of progress toward satisfying the performance obligation.

The Company recognized $3.2 million, $6.1 million and $1.0 million during the years ended December 31, 2019, 2018 and 2017, respectively, as revenue associated with the first target under the BI Agreement in the accompanying consolidated statement of operations. The performance obligation associated with the first target had been satisfied as of December 31, 2019.

BI contract amendment – Background

In October 2018, BI exercised its Second Target option, which entitled the Company to a non-refundable payment of $5.0 million and reimbursement of $0.7 million for certain third-party expenses upon the agreement of a research work plan and budget for the Second Target. The terms of the Second Target option exercise and related rights and obligations associated with the Second Target were agreed between the Company and BI in an Additional Target Agreement (the "ATA"), which was entered into on December 31, 2018.

Under the terms of the ATA, BI is responsible for future clinical development and commercialization of candidate products for the Second Target. Additionally, during the term of the research program, BI will reimburse the Company for certain expenses. The Company is eligible to receive up to $170.0 million in potential development and commercial milestones related to the Second Target. The Company is also eligible to receive tiered royalty payments on potential global net sales, subject to certain adjustments, in the mid-single digits. Except as otherwise set forth in the ATA, development of the Second Target is subject to the terms of the original BI Agreement.

BI contract amendment – Accounting Analysis

The exercise of the Second Target option on December 31, 2018 through the ATA created a new arrangement for accounting purposes, and management determined that the $5.0 million exercise price with the $0.7 million of reimbursable expenses was representative of the standalone selling price. Consistent with the reasons described related to the initial target, management concluded that the non-refundable Second Target option exercise fee (akin to an upfront payment) constituted the amount of the consideration to be included in the transaction price and has been allocated to the single performance obligation. The basis for the conclusions regarding the treatment of development and sales-based milestones associated with the Second Target are consistent with those associated with the initial combined performance obligation under the BI Agreement. The Company re-evaluates the transaction price in each reporting period and as uncertain events are resolved or other changes in circumstances occur.

The Company began recognizing the $5.7 million transaction price as revenue in January 2019 and will continue recognizing as revenue over the Company's best estimate of the period during which it will be obligated to provide research support services to BI, currently estimated to end in October 2020.

Consistent with the first target, revenue is recognized on a straight-line basis, which is in management's judgment an appropriate measure of progress toward satisfying the performance obligation. The Company recognized $3.1 million associated with the Second Target under the BI Agreement during the year ended December 31, 2019. The aggregate amount of the transaction price allocated to the Company's partially unsatisfied performance obligation and recorded as deferred revenue at December 31, 2019 is $2.3 million, all of which is included in the current portion of deferred revenue.

In addition to establishing the terms of the Second Target option exercise, the ATA also amends the BI Agreement to provide the parties the opportunity to consider the development of product candidates targeting a further additional target gene (the "Third Target Option").

Per the ATA, if BI elects, following Dicerna's presentation of data for a new product candidate, to exercise the Third Target Option, the parties must also agree to a research work plan and budget for the additional gene and negotiate development and commercialization milestones and royalty payments to the Company, and upon such agreement and exercise, BI would make an option fee payment to the Company of $5.0 million. This option exercise fee is consistent with the Second Target option exercise fee, which management concluded was representative of the standalone selling price. If BI chooses to exercise the Third Target Option, the Company will be responsible for the discovery and initial profiling of the product candidates, including primary preclinical studies, synthesis, and delivery. BI will be responsible for evaluating and selecting the product candidates for further development. If BI selects one or more product candidates, it will be responsible for further preclinical development, clinical development, manufacturing, and commercialization of those products. If the Third Target Option is exercised, such exercise would result in a new arrangement for accounting purposes, as the licensing rights and research and development services underlying the Third Target Option are distinct from those associated with the initial and Second Targets.

The following table presents changes in the Company's aggregate deferred revenue balances for each reporting period:

	YEAR ENDED DECEMBER 31, 2019			
	BALANCE AT BEGINNING OF PERIOD	ADDITIONS	DEDUCTIONS	BALANCE AT END OF PERIOD
Deferred revenue, current and noncurrent	$ 183,186	$ 235,631	$ (23,829)	$ 394,988

	YEAR ENDED DECEMBER 31, 2018			
	BALANCE AT BEGINNING OF PERIOD	ADDITIONS	DEDUCTIONS	BALANCE AT END OF PERIOD
Deferred revenue, current and noncurrent	$ 9,270	$ 180,092	$ (6,176)	$ 183,186

9. STOCKHOLDERS' EQUITY

Preferred stock

The Company has authorized up to 5,000,000 shares of preferred stock, $0.0001 par value per share, for issuance. The preferred stock will have such rights, preferences, privileges and restrictions, including voting rights, dividend rights, conversion rights, redemption privileges, and liquidation preferences, as shall be determined by the Company's board of directors upon its issuance. At December 31, 2019 and 2018, there were no shares of preferred stock outstanding.

As further disclosed in Note 10, during the year ended December 31, 2017, the Company issued and sold in a private placement 700,000 shares of its newly designated redeemable convertible preferred stock, par value $0.0001 per share. Redeemable convertible preferred shares and the shares of common stock issuable upon conversion of the redeemable convertible preferred stock were offered and sold by the Company pursuant to an exemption from the registration requirements of the Securities Act provided by Section 4(a)(2) thereunder. On December 18, 2017, the Company completed the conversion of the redeemable convertible preferred stock and issued an aggregate of 24,206,663 shares of the Company's common stock.

Issuances of Common Stock

On December 18, 2017, the Company completed an underwritten follow-on public offering of 5,714,286 shares of common stock (the "2017 Offering"), which was made pursuant to the Company's effective registration statement on Form S-3 previously filed with the Securities and Exchange Commission ("SEC"). In connection with the 2017 Offering, the Company entered into an underwriting agreement (the "2017 Underwriting Agreement") with Stifel, Nicolaus & Company, Incorporated and Evercore Group LLC as representatives of the underwriters listed in the 2017 Underwriting Agreement (collectively, the "2017 Underwriters"), pursuant to which the Company granted to the 2017 Underwriters a 30-day option to purchase up to an additional 857,143 shares of the

Company's common stock (the "Overallotment"). The Company completed the sale of 6,571,428 shares, inclusive of the Overallotment, to the 2017 Underwriters on December 18, 2017, and that sale resulted in the receipt by the Company of aggregate gross proceeds of $46.0 million, less underwriter commissions and additional offering expenses totaling approximately $3.2 million.

On April 20, 2018, the Company entered into a Share Issuance Agreement with Alnylam ("Alnylam Share Issuance Agreement"), pursuant to which the Company agreed to issue to Alnylam 983,208 shares in satisfaction of the Company's obligation under the Settlement Agreement to deliver shares to Alnylam (see Note 15). The Alnylam Share Issuance Agreement contains customary representations and warranties of each party. The transaction contemplated by the Alnylam Share Issuance Agreement was closed on April 24, 2018.

On September 11, 2018, the Company completed an underwritten follow-on public offering of 7,680,492 shares of common stock (the "2018 Offering"). In connection with the 2018 Offering, the Company entered into an underwriting agreement (the "2018 Underwriting Agreement") with Citigroup Global Markets Inc. and Leerink Partners LLC as representatives of the underwriters listed in the 2018 Underwriting Agreement (collectively, the "2018 Underwriters"), pursuant to which the Company granted to the 2018 Underwriters a 30-day option to purchase up to an additional 1,152,073 shares of the Company's common stock. Upon completion of the sale of 8,832,565 shares to the 2018 Underwriters, the Company received gross proceeds of $115.0 million.

In connection with the Alexion Collaboration Agreement, the Company and Alexion entered into the Alexion Share Issuance Agreement on October 22, 2018, pursuant to which the Company sold to Alexion 835,834 shares of the Company's common stock at $17.95 per share for an aggregate purchase price of approximately $15.0 million, of which $9.1 million was allocated to the share issuance for accounting purposes.

In connection with the Lilly Collaboration Agreement, the Company and Lilly entered into the Lilly Share Issuance Agreement on October 25, 2018, pursuant to which the Company sold to Lilly 5,414,185 shares of common stock at $18.47 per share for an aggregate purchase price of approximately $100.0 million, of which $51.3 million was allocated to the share issuance for accounting purposes. The closing of the transactions contemplated by the Lilly Collaboration Agreement and the Lilly Share Issuance Agreement occurred on December 19, 2018.

In connection with the Novo Collaboration Agreement, the Company and Novo entered into the Novo Share Issuance Agreement on November 15, 2019, pursuant to which the Company sold to Novo 2,279,982 shares of common stock at $21.93 per share for an aggregate purchase price of approximately $50.0 million, of which $45.8 million was allocated to the share issuance for accounting purposes. The closing of the transactions contemplated by the Novo Collaboration Agreement and the Novo Share Issuance Agreement occurred on December 27, 2019.

10. REDEEMABLE CONVERTIBLE PREFERRED STOCK

On April 11, 2017, pursuant to a redeemable convertible preferred stock purchase agreement ("SPA") with seven institutional investors (the "Preferred Holders"), led by funds advised by Bain Capital Life Sciences L.P. ("Lead Investor"), the Company issued and sold in a private placement 700,000 shares of its newly designated redeemable convertible preferred stock, par value $0.0001 per share, at a purchase price of $100.00 per share, for total gross proceeds of $70.0 million ("Private Placement"), less issuance costs of approximately $0.8 million. The redeemable convertible preferred shares and the shares of common stock issuable upon conversion of the redeemable convertible preferred stock were offered and sold by the Company pursuant to an exemption from the registration requirements of the Securities Act provided by Section 4(a)(2) thereunder.

In addition to the Lead Investor, other participants in the Private Placement included affiliates of Cormorant Asset Management, LLC, Domain Associates, LLC ("Domain Associates"), EcoR1 Capital, LLC, RA Capital Management, LLC ("RA Capital") and Skyline Management LLC ("Skyline Ventures"), among others. Domain Associates, RA Capital and Skyline Ventures are entities that are affiliated or were formerly affiliated with certain members of the Company's board of directors. On March 28, 2017, in accordance with the terms of the SPA, the Company increased the size of its board of directors from eight to nine directors and approved the appointment of Adam M. Koppel, M.D., Ph.D., a managing director of the Lead Investor, as a director of the Company, effective as of the closing of the Private Placement on April 11, 2017. Dr. Koppel was reelected to the Company's board of directors by shareholder vote in June 2017.

The redeemable convertible preferred stock had the rights and preferences set forth in a Certificate of Designation, which was filed with the Secretary of State of the State of Delaware.

Inducement and conversion

On December 13, 2017, in connection with the 2017 Offering, defined and discussed in Note 9, the Company entered into a letter agreement (the "Letter Agreement") with the Preferred Holders. Pursuant to the Letter Agreement, the Preferred Holders agreed,

subject to the completion of the 2017 Offering, to optionally convert all of their shares of redeemable convertible preferred stock, to the extent not subject to Conversion Blockers, into common stock, and consented, where applicable, to the repurchase of the residual shares of common stock that would have been issuable but for the Conversion Blockers (the "Residual Shares") for $0.0001 per share. "Conversion Blockers" refers to the beneficial ownership limitations in the Company's Certificate of Designation of the redeemable convertible preferred stock, which included (i) a 19.99% blocker provision to comply with Nasdaq Listing Rules, (ii) if so elected by a holder, a 9.99% blocker provision that would have prohibited beneficial ownership of more than 9.99% of the outstanding shares of the Company's common stock or voting power at any time, and (iii) ownership limitations resulting from applicable regulatory restrictions.

The Letter Agreement also provided for Preferred Holders to waive and amend certain provisions in an amended and restated registration rights agreement by and among the Company and the Preferred Holders party thereto (the "Registration Rights Agreement"). In consideration for the Preferred Holders' agreeing to the optional conversion of the redeemable convertible preferred stock and to a waiver under and certain amendments to the Registration Rights Agreement, the Company agreed to issue to the Preferred Holders pre-funded warrants (the "Pre-Funded Warrants"), exercisable in part or in whole at any time upon grant for shares of the Company's common stock at a price per share of $0.0001 per share. Each Preferred Holder was entitled to elect to receive shares of the Company's common stock in lieu of the Pre-Funded Warrants that otherwise would have been issued to such Preferred Holder subject to any applicable Conversion Blockers. Under the Letter Agreement, the number of shares allocable to each Preferred Holder was calculated based on the sum of (i) the number of shares of common stock into which the additional dividend accruals on the redeemable convertible preferred stock that such Preferred Holders would have been entitled to receive up to and including March 31, 2018 would have been convertible, calculated immediately prior to the effectiveness of the conversion and (ii) any Residual Shares repurchased, or to be repurchased, from such Preferred Holder by the Company as described above (collectively, the "Additional Investor Shares"). The formula for the Additional Investor Shares assumes (1) a conversion price of $3.19 per share of common stock; (2) application of a dividend rate of 12% per annum from April 11, 2017 to October 27, 2017 and (3) application of a dividend rate of 8% per annum commencing from October 27, 2017 through March 31, 2018.

On December 18, 2017, the Company completed the conversion of the redeemable convertible preferred stock and issued an aggregate of 24,206,663 shares of the Company's common stock. No Pre-Funded Warrants were issued in connection with the conversion of the redeemable convertible preferred stock, as all Preferred Holders opted to receive common shares in lieu of Pre-Funded Warrants, largely given the inapplicability of Conversion Blockers as of the date of conversion, immediately after which no shares of redeemable convertible preferred stock remained outstanding.

On December 29, 2017, the Company filed with the Secretary of State of the State of Delaware a Certificate of Elimination of the Redeemable Convertible Preferred Stock, which eliminates from the Company's Certificate of Incorporation all matters set forth in the Certificate of Designation of Redeemable Convertible Preferred Stock previously filed with the Secretary of State of the State of Delaware, which established and designated the redeemable convertible preferred stock and the rights, powers, preferences, privileges and limitations thereof.

Upon conversion of the redeemable convertible preferred stock, the Company applied the guidance outlined in the FASB's Accounting Standard Codification ("ASC") Topic 470-20, Debt with Conversion and Other Options ("ASC 470-20"), which contains guidance addressing the accounting for induced conversions of convertible debt, which in turn, per the U.S. Securities and Exchange Commission's ("SEC") guidance codified in ASC Topic 260, Earnings per Share ("ASC 260"), should be applied also to induced conversions of convertible preferred stock.

The Company applied the guidance provided in ASC 260-10-S99-2 and compared the fair value of common stock transferred in the conversion transaction to the Preferred Holders to the fair value of common stock issuable pursuant to the original conversion terms. The resulting excess, which amounted to approximately $3.8 million, was recorded as a deemed dividend on conversion of the redeemable convertible preferred shares and has been added to net loss to arrive at net loss attributable to common stockholders in the accompanying consolidated statement of operations for the year ended December 31, 2017.

Dividends

Each holder of redeemable convertible preferred stock had been entitled to receive cumulative dividends on the Accrued Value, as defined below, of each share of redeemable convertible preferred stock at an initial rate of 12% per annum, compounded quarterly and subject to two rate reductions of 4% each in connection with the occurrence of one of the agreed-upon milestone events. Entering into the BI Agreement, as defined and discussed in Note 8, constituted, per the Certificate of Designation, a milestone event for purposes of applying the first of two allowable rate reductions to dividends payable on the redeemable convertible preferred stock. As such, the dividend rate on the redeemable convertible preferred stock was reduced from 12% to 8% effective on October 27, 2017. Dividends on the redeemable convertible preferred stock accrued on the Accrued Value of each share of redeemable convertible preferred until the conversion thereof, which occurred on December 18, 2017, as discussed above. "Accrued Value" meant, with respect to each share of redeemable convertible preferred stock, the sum of (i) $100.00 plus (ii) on each quarterly dividend date, an additional amount equal

to the dollar value of any dividends on a share of redeemable convertible preferred stock which had accrued on any dividend payment date and had not previously been added to such Accrued Value.

For accounting purposes, in accordance with ASC Topic 480-10-S99, Distinguishing Liabilities from Equity – SEC Materials ("ASC 480-10-S99"), the Company recorded the dividends at fair value at each dividend declaration date. The fair value of the dividends was determined using a binary lattice model that captured the intrinsic value of the underlying common stock on the declaration date and the option value of the shares and future dividends.

The lattice model was used to determine fair value of dividends on each dividend date through September 30, 2017, which was the last dividend date prior to conversion of the redeemable convertible preferred shares, included the following inputs:

	JUNE 30, 2017	SEPTEMBER 30, 2017
Price per common share	$ 3.17	$ 5.75
Expected term (in years)	6.75	6.50
Expected volatility	70.0%	73.0%
Risk-adjusted discount rate	18.0%	19.1%

In addition to the inputs presented above, use of the lattice model applied other assumptions, including probability simulations of various outcomes largely associated with the conversion-related milestone events referred to above and with the progression of the Company's per common share price. Use of the lattice model resulted in a fair value estimate of the aggregate dividends declared on June 30, 2017 and September 30, 2017 of $1.9 million and $4.1 million, respectively.

Beneficial conversion feature

In accordance with ASC Topic 470-20, the Company recorded a beneficial conversion feature ("BCF") related to the issuance of the redeemable convertible preferred. The BCF was recognized separately at issuance by allocating a portion of the proceeds equal to the intrinsic value of that feature to additional paid-in capital. The BCF was calculated at the commitment date, which management has determined to be the date of issuance. Intrinsic value is calculated as the difference between the effective conversion price and the fair value of the Company's common stock, multiplied by the number of shares into which the issued shares of redeemable convertible preferred shares are convertible. During the year ended December 31, 2017, the Company recorded a deemed dividend charge of $6.1 million, to reflect full and immediate accretion of the discount resulting from the at-issuance BCF embedded within the redeemable convertible preferred stock as a result of the shares being immediately convertible into shares of the Company's common stock at the option of the Preferred Holders.

Accretion of the discount resulting from the BCF and cumulative dividends, including accretion of share issuance costs, were non-cash transactions and have been reflected below net loss to arrive at net loss attributable to common stockholders.

The following table reflects the changes in redeemable convertible preferred shares recorded during the year ended December 31, 2017:

Balance at January 1, 2017	$ —
Issuance of redeemable convertible preferred shares	70,000
Share issuance costs	(750)
Net proceeds	69,250
Discount resulting from the BCF at issuance	(6,144)
Accretion of the discount resulting from the BCF (deemed dividend)	6,144
Dividends accrued at the stated rates	5,515
Fair value in excess of dividends accrued at the stated rates	3,846
Accretion of share issuance costs (additional dividends)	750
Balance immediately prior to conversion	79,361
Conversion of redeemable convertible preferred shares	(79,361)
Balance at December 31, 2017	$ —

11. STOCK-BASED COMPENSATION

Equity Incentive Plans

As of December 31, 2019, the Company's approved equity incentive plans include: the Third Amended and Restated 2007 Employee, Director and Consultant Stock Plan ("2007 Plan"); the 2010 Employee, Director and Consultant Equity Incentive Plan ("2010 Plan"); the 2014 Employee Stock Purchase Plan ("2014 ESPP"); the Amended and Restated 2014 Performance Incentive Plan ("2014 Plan"); and the 2016 Inducement Plan ("2016 Plan"). These plans are administered by the board of directors and permit the granting of stock options, stock appreciation rights, stock bonuses, restricted stock, performance stock, stock units, phantom stock, or similar rights to purchase or acquire shares. Upon adoption of the 2014 Plan, the Company no longer grants new equity awards under its 2007 Plan or 2010 Plan.

Amended and Restated 2014 Performance Incentive Plan

On January 14, 2014, the board of directors adopted the 2014 Plan which authorized the issuance of up to 1,900,000 shares of the Company's common stock, with an additional increase on the first trading day in January of each calendar year during the term of the plan by an amount equal to 4% of the total number of shares of Common Stock issued and outstanding on December 31 of the immediately preceding calendar year. In June 2015, the 2014 Plan was amended to increase the replenishment percentage from 4% to 5% of outstanding common shares annually and to allow the reissuance thereunder of awards and grants that expire or are canceled, terminated, forfeited, or fail to vest under the 2007 Plan and 2010 Plan, as amended. Stock options for new hires granted under this plan generally vest 25% after 12 months, followed by ratable vesting over the remaining 36-month term and expire 10 years from the grant date. Annual promotional and incentive-related grants generally vest ratably over a period of 48 months. As of December 31, 2019, there were 8,575,043 stock options outstanding and 1,371,670 shares of common stock reserved for future issuance under the 2014 Plan.

Inducement Grants

During 2014 and 2015, the Company granted 470,272 and 450,700 stock options, respectively, as an inducement material to individuals entering into employment with the Company ("Inducement Grants"). The Inducement Grants were approved by the Compensation Committee of the Company's board of directors and were awarded in accordance with Nasdaq Listing Rule 5635(c)(4) and outside of the 2014 Plan. As such, any shares underlying the Inducement Grants are not, upon forfeiture, cancellation, or expiration, returned to a pool of shares reserved for future issuance. As of December 31, 2019, there were 130,000 Inducement Grants that remained outstanding.

2016 Inducement Plan

On March 4, 2016, the board of directors adopted the 2016 Plan pursuant to which the Company may grant options to purchase common shares as an inducement to individuals to join the Company. The 2016 Plan, as adopted, allowed the Company to deliver up to 250,000 shares (the "Share Limit") of its common stock to eligible persons, as defined. The Share Limit is subject to adjustment as contemplated by the provisions of the 2014 Plan. In February and May 2017, the Share Limit was adjusted to increase the pool of issuable options by 125,000 and 200,000 underlying shares, respectively. On December 11, 2018, the board of directors approved a resolution to further increase the Share Limit under the 2016 Plan by 2,700,000 to 3,275,000 underlying shares. In December 2019, the Company's Board of Directors authorized an additional 2,900,000 shares for issuance under the 2016 Plan. As of December 31, 2019, there were 3,005,313 stock options outstanding and 3,043,500 shares of common stock reserved for future issuance under the 2016 Plan.

Stock-based compensation expense

The Company has classified stock-based compensation expense in its consolidated statements of operations as follows:

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
Research and development	$ 8,413	$ 3,062	$ 3,536
General and administrative	10,409	4,826	4,234
Total	$ 18,822	$ 7,888	$ 7,770

Stock options

Expected volatility for the Company's common stock was determined based on an average of the historical volatility of a peer group of similar companies due to limited historical volatility of the Company's own common stock. The Company also has limited stock option exercise information, and as such, the expected term of stock options granted was calculated in most cases using the simplified method, which represents the average of the contractual term of the stock option and the weighted-average vesting period of the stock option. The assumed dividend yield is based upon the Company's expectation of not paying dividends in the foreseeable future. The risk-free rate for periods within the expected life of the stock option is based upon the U.S. Treasury yield curve in effect at the time of grant.

The assumptions used in the Black-Scholes option-pricing model for all stock options granted during each period presented are as follows:

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
Common stock price	$10.31 - $26.48	$9.14 - $15.74	$2.49 - $9.71
Expected option term (in years)	5.28 - 6.08	5.50 - 6.25	5.50 - 6.25
Expected volatility	78.3% - 80.8%	75.9% - 78.3%	79.4% - 91.1%
Risk-free interest rate	1.4% - 2.6%	2.3% - 3.0%	1.9% - 2.2%
Expected dividend yield	0.0%	0.0%	0.0%

The table below summarizes the activity under the Company's equity incentive plans:

	NUMBER OF OPTIONS	WEIGHTED-AVERAGE EXERCISE PRICE	WEIGHTED-AVERAGE REMAINING CONTRACTUAL TERM (YEARS)	AGGREGATE INTRINSIC VALUE
OUTSTANDING – JANUARY 1, 2019	7,787,690	$9.36		
Granted	5,934,000	$13.23		
Exercised	(963,318)	$6.90		
Forfeited/Canceled	(268,022)	$10.20		
Expired	(23,200)	$3.42		
OUTSTANDING – DECEMBER 31, 2019	12,467,150	$11.38	7.4	$ 133,548
EXERCISABLE – DECEMBER 31, 2019	5,987,801	$10.27	5.8	$ 70,406
VESTED AND EXPECTED TO VEST – DECEMBER 31, 2019	11,852,807	$11.27	7.3	$ 128,199

The weighted-average grant date fair value of stock options granted during the years ended December 31, 2019, 2018, and 2017 was $9.11, $7.64, and $2.52 per share, respectively. As of December 31, 2019, there was $52.0 million of unrecognized compensation cost related to unvested employee stock options which are expected to be recognized over a weighted-average period of 3.0 years. The intrinsic value of stock options exercised was $15.2 million, $2.9 million, and $0.1 million for the years ended December 31, 2019, 2018, and 2017, respectively.

The Company does not currently hold any treasury shares. Upon stock option exercise, the Company issues new shares and delivers them to the participant.

Restricted common stock

In 2014, the Company issued a total of 44,000 shares of the Company's restricted common stock, of which 4,000 shares were fully vested at the grant date and the remaining shares were scheduled to vest in equal tranches over a four-year period on the anniversary date of the related grant. The fair value of these shares totaled $0.7 million at the grant date, representing a weighted-average grant date fair value per share of $16.30.

At December 31, 2017, there were 10,000 shares of the Company's restricted common stock remaining outstanding with a weighted-average grant date fair value of $16.30. During the year ended December 31, 2018, all 10,000 shares of restricted common stock with a weighted-average grant date fair value of $16.30 vested and there are no outstanding shares of restricted common stock at December 31, 2018. The total fair value of restricted common stock vested during the year ended December 31, 2018 was $0.1 million. The total fair value of restricted common stock that vested during the year ended December 31, 2017 was immaterial.

Common stock warrants

During the year ended December 31, 2018, certain warrant holders exercised warrants to purchase 85,703 shares of the Company's common stock on a net basis and received 45,710 shares of common stock, and 39,993 shares were used to cover the exercise price of $7.00 per share.

At both December 31, 2018 and 2019, there were 2,198 common stock warrants remaining outstanding with an exercise price of $250.00 per share. The remaining contractual life of the common stock warrants as of December 31, 2018 and 2019 was 1.46 years and 0.46 years, respectively.

Employee stock purchase plan

On January 28, 2014, the Company's stockholders approved the 2014 ESPP, which authorized the issuance of up to 1,000,000 shares of common stock thereunder. The 2014 ESPP provides for an automatic reserve increase equivalent to the lesser of 1% of the total number of shares of common stock issued and outstanding on December 31 of the immediately preceding calendar year and 1,000,000 shares of common stock, unless otherwise determined by the Company's board of directors. As of December 31, 2019, there were 2,789,898 shares of common stock authorized and 2,404,287 shares of common stock available for issuance under the 2014 ESPP.

Eligible employees may purchase shares of the Company's common stock through regular payroll deductions up to 15% of their eligible compensation. Under the terms of the offering under the 2014 ESPP, the number of shares purchased by an individual participant in the plan may not exceed 10,000 shares in any one purchase period. In addition, the fair market value of shares purchased by an individual participant in the plan may not exceed $25,000 if the contribution period is within any one calendar year. Participants are allowed to terminate their participation in the ESPP at any time during the purchase period prior to the purchase of the shares. The offering periods have a 24-month term, which consists of four purchase periods, each of which is six months in duration. New offering periods commence on the first day of January and July each year and end on the last business day of the immediately following June or December, respectively.

The per-share purchase price at the end of each offering period is equal to the lesser of 85% of the fair market value of the common stock on the grant date of the offering period to which the purchase period relates or 85% of the fair market value of the common stock on the purchase date of the applicable purchase period. In the event that the fair value of the common stock on any purchase date during an offering period is lower than the fair market value of the common stock on the grant date of that offering period, that offering period will terminate on such purchase date, and each participant in such terminated offering period will be automatically enrolled in the new offering period that commences on the first business day of the next offering period that immediately follows such purchase date.

Shares issued under the 2014 ESPP are considered compensatory. Accordingly, the Company is required to measure the fair value of the stock purchase rights granted and record compensation expense for share purchase rights granted under the 2014 ESPP. The fair values of the stock purchase rights are estimated using the Black-Scholes option-pricing model, which relies on a number of key assumptions in calculating the estimates of fair value. Stock-based compensation expense related to stock purchase rights under the 2014 ESPP was $0.7 million, $0.1 million, $0.4 million for the years ended December 31, 2019, 2018, and 2017, respectively.

During the years ended December 31, 2019, 2018, and 2017, the Company issued 122,999, 118,239, and 84,890 shares of common stock under the 2014 ESPP, respectively. The weighted-average purchase prices of shares issued under the 2014 ESPP were $6.97, $2.61, and $2.45 per share for the years ended December 31, 2019, 2018, and 2017, respectively.

12. 401(K) PROFIT SHARING PLAN AND TRUST

The Company has a 401(k) Profit Sharing Plan and Trust ("401(k) Plan"), which is a retirement plan in which substantially all employees are eligible to participate. Eligible employees may elect to contribute up to the maximum limits, as set by the Internal Revenue Service, of their eligible compensation. Under the terms of the 401(k) Plan, employees may elect to make pre-tax and Roth contributions through payroll deductions within statutory and plan limits. The Company makes matching contributions of 300% of eligible employee salary deferrals that do not exceed 2% of the eligible participant's compensation. All matching contributions vest immediately. Each year, the Company may also make a discretionary profit-sharing contribution to the plan. Such contributions to the Plan are allocated among eligible participants in the proportion of their salaries to the total salaries of all participants.

Expense recognized by the Company for matching contributions made to the 401(k) Plan was $1.2 million, $0.6 million, and $0.4 million for the years ended December 31, 2019, 2018, and 2017, respectively. There were no discretionary profit-sharing contributions made by the Company during the years ended December 31, 2019, 2018, or 2017.

13. INCOME TAXES

The Company has no current and no deferred income tax expense for the years ended December 31, 2019 and 2018. The Company did not record a federal income tax provision or benefit for the years ended December 31, 2019, 2018, and 2017.

The reconciliation between income taxes computed at the federal statutory income tax rate and the provision for (benefit from) income taxes is as follows:

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
Federal statutory rate	21.0 %	21.0 %	34.0 %
Effect of:			
Foreign rate differential	(5.9)%	(9.5)%	(17.6)%
Tax reform	— %	— %	(29.6)%
Net operating loss limitation	17.0 %	(23.0)%	— %
Change in valuation allowance	(29.7)%	10.6 %	13.5 %
Foreign income/GILTI[(a)]	(8.0)%	— %	— %
Stock-based compensation expense	1.7 %	0.4 %	(0.8)%
Other	3.9 %	0.5 %	0.5 %
Total	— %	— %	— %

[(a)]GILTI represents Global Intangible Low-Tax Income

The components of the Company's deferred tax assets and liabilities are as follows:

	DECEMBER 31,	
	2019	2018
Deferred tax assets:		
Net operating loss carryforwards	$ 58,319	$ 24,739
Capitalized research and development costs	415	516
Research and development credit carryforwards	7,386	3,988
Lease liability	6,905	—
Stock-based compensation expense	11,751	7,644
Depreciation expense and other costs	408	75
Deferred tax assets	85,184	36,962
Deferred tax liabilities:		
Right-of-use asset	(6,833)	—
Intangible assets	(1,939)	—
Deferred revenue	(492)	
Deferred tax liabilities	(9,264)	—
Valuation allowance	(75,920)	(36,962)
Net deferred tax assets	$ —	$ —

On December 22, 2017, the Tax Cuts and Jobs Act (the "TCJA") was signed into law in the United States. The TCJA reduced the U.S. corporate tax rate from 34% to 21% for tax years beginning after December 31, 2017. Other relevant provisions of the TCJA did not have a material impact on the accompanying consolidated financial statements.

As a result of certain changes in applicable Cayman Islands law, certain changes in U.S. tax law, and related business considerations, we undertook certain restructuring transactions in 2019 that resulted in the liquidation of Dicerna Cayman, which was a wholly owned subsidiary of Dicerna Pharmaceuticals, Inc. that previously held intellectual property rights. That liquidation was accomplished initially via an election to treat Dicerna Cayman as a disregarded entity separate from Dicerna Pharmaceuticals, Inc. for U.S. federal income tax purposes, effective July 1, 2019; thereafter, Dicerna Cayman was dissolved under applicable Cayman Islands law. As a result of these transactions, all the pre-liquidation assets and liabilities of Dicerna Cayman, including certain intellectual property rights, are now assets and liabilities of Dicerna Pharmaceuticals, Inc.

Management has evaluated the positive and negative evidence bearing upon the realizability of the Company's net deferred tax assets and has determined that it is more likely than not that the Company will not recognize the benefits of the net deferred tax assets. As a result, the Company has recorded a full valuation allowance at December 31, 2019 and 2018.

Realization of the future tax benefits is dependent on many factors, including the Company's ability to generate taxable income within the net operating loss carryforward period. Under the provisions of the Internal Revenue Code ("IRC"), certain substantial changes in the Company's ownership, including a sale of the Company or significant changes in ownership due to sales of equity, may have limited, or may limit in the future, the amount of net operating loss carryforwards which could be used annually to offset future taxable income. As of December 31, 2019, the Company has approximately $202.8 million of net operating losses, of which $125.1 million are subject to the IRC 382 limitation. None of these IRC 382 limited net operating losses are expected to expire before utilization.

As of December 31, 2019, the Company had approximately $202.8 million of federal and $196.6 million of state net operating loss carryforwards. If not utilized, the federal and state net operating loss carryforwards expire starting in 2029 and 2030, respectively. Additionally, as of December 31, 2019, the Company had $7.1 million of federal and $3.3 million of Massachusetts tax credits that expire starting in 2028 and 2023, respectively.

As of December 31, 2019, the Company had $3.0 million of unrecognized tax benefits, all of which would affect income tax expense if recognized, before consideration of the Company's valuation allowance. The Company does not expect the unrecognized tax benefits to change significantly over the next 12 months. The Company recognizes both interest and penalties associated with uncertain tax positions as a component of income tax expense. As of December 31, 2019 and 2018, the Company had no accrued penalties or provisions for interest.

A reconciliation of the gross unrecognized tax benefits are as follows:

	YEAR ENDED DECEMBER 31,	
	2019	2018
Unrecognized tax benefits at the beginning of the period	$ 1,631	$ 1,451
Additions for current tax positions	1,426	211
Changes for previous tax positions	(17)	(31)
Unrecognized tax benefits at the end of the period	$ 3,040	$ 1,631

The Company files income tax returns in the United States, the Commonwealth of Massachusetts, Colorado, Maryland, North Carolina, New York, and New Jersey. The tax years 2008 through 2018 remain open to examination by these jurisdictions, as carryforward attributes generated in past years may be adjusted in a future period. The Company is not currently under examination by the Internal Revenue Service or any other jurisdiction for these years. The Company has not recorded any interest or penalties for unrecognized tax benefits since its inception.

14. LEASES

On July 11, 2014, the Company executed a noncancelable operating lease for office and laboratory space in Cambridge, Massachusetts (the "First Cambridge Lease"). The lease agreement, the term of which commenced on December 1, 2014, obligates the Company to make minimum payments totaling $9.6 million over a six-year lease term ending November 30, 2020. The Company has the option to extend the lease term for one additional five-year period. Rent expense is recorded on a straight-line basis. As part of the Company's lease agreement, the Company established a letter of credit, secured by a money market investment, the balance of which is presented as restricted cash equivalents at December 31, 2019 and 2018. The Company also leases a small office in Cambridge, Massachusetts which has a 30-month term without a renewal option (the "Second Cambridge Lease" and together with the First Cambridge Lease, the "Cambridge Leases").

In addition, on January 2, 2019, Dicerna executed a lease for laboratory and office space in Lexington, Massachusetts (the "Lexington Lease") that commenced for accounting purposes on November 3, 2019. The term of the Lexington Lease is seven years with approximately $30.1 million in fixed payments and consideration for the first partial calendar month. The Company has the option to extend the lease term at a prevailing market rate as of the extension date, which is seven years after the Lexington Lease commencement date. As part of the Company's lease agreement, the Company is required to establish a $2.8 million letter of credit, secured by money market investments, which is presented as restricted cash equivalents at December 31, 2019.

On August 26, 2019, the Company entered into a lease agreement for 15,781 square feet of office space in Boulder, Colorado (the "Boulder Lease") that had not commenced for accounting purposes as of December 31, 2019. Due to the fact that the Boulder Lease

had not commenced as of December 31, 2019, the Company has not yet recognized a ROU asset or lease liability on the consolidated balance sheet for the Boulder Lease; however, the Company is currently utilizing a small amount of temporary office space as provided for in the Boulder Lease. The term of the lease is 87 full calendar months plus any partial month from the commencement date to the end of the month in which the commencement date falls with approximately $3.0 million in aggregate fixed payments over the term of the lease arrangement. The Boulder Lease also provides the option to extend the term for up to two additional periods of 60 months each. As part of the agreement for the Boulder Lease, the Company was required to establish a $0.4 million letter of credit, secured by money market investments, which is presented as restricted cash equivalents at December 31, 2019. On February 4, 2020, the Company entered into an amendment to a real property lease agreement for our office location in Boulder, Colorado; refer to Note 17 – Subsequent Events for further information. The Company currently expects the lease of the space under the amendment to commence for accounting purposes in the first quarter of 2020, and expects to commence occupancy of the remainder of the facility in the second quarter of 2020.

Payments due under each lease agreement include fixed and variable payments. Variable payments relate to the Company's share of the lessors' operating costs associated with the underlying assets and are recognized when the event on which those payments are assessed occurs. None of the Company's operating leases contain residual value guarantees.

The interest rate implicit in lease agreements is typically not readily determinable, and as such, the Company utilizes the incremental borrowing rate to calculate lease liabilities, which is the rate incurred to borrow, on a collateralized basis over a similar term, an amount equal to the lease payments in a similar economic environment. ROU assets from finance leases are recorded within property and equipment on the consolidated balance sheets.

Future lease payments for noncancelable leases as of December 31, 2019 is as follows:

	OPERATING LEASES [1]	FINANCE LEASE
2020	$ 5,968	$ 52
2021	4,244	48
2022	4,172	48
2023	4,297	48
2024	4,426	44
Thereafter	8,853	—
Total undiscounted lease payments	31,960	240
Less: imputed interest expense	(8,003)	(45)
Total lease liabilities	$ 23,957	$ 195

[1] Excluded from the table above are lease payments associated with our newest lease in Lexington, Massachusetts that has not commenced for accounting purposes as of December 31, 2019. Under generally accepted accounting principles, the commencement date is the date on which the asset is made available to the Company by the lessor.

The components of lease cost in the Company's consolidated statements of operations are as follows:

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
Operating leases			
Fixed lease cost	$ 2,747	$ 1,634	$ 1,582
Variable lease cost	1,915	—	—
Total operating lease cost	$ 4,662	$ 1,634	$ 1,582
Finance lease			
Amortization expense	$ 6	$ —	$ —
Interest expense	3	—	—
Total finance lease cost	$ 9	$ —	$ —

Amounts reported in the consolidated balance sheet for leases in which the Company is the lessee as of December 31, 2019 were as follows:

	OPERATING LEASES	FINANCE LEASES
Lease ROU assets	$ 30,102	$ 186
Lease liabilities	23,957	195
Weighted-average remaining lease term	6.48	4.88
Weighted-average discount rate	9.00%	9.00%

Other information related to the Company's leases is as follows:

	YEAR ENDED DECEMBER 31,		
	2019	2018	2017
Cash paid for amounts included in the measurement of lease liabilities			
Operating cash flows from operating leases	$ 8,966	$ 1,634	$ 1,582
Financing cash flows from finance leases	$ —	$ —	$ —
Right-of-use assets obtained in exchange for lease liabilities			
Operating leases	$ 32,412	$ —	$ —
Finance leases	$ 193	$ —	$ —

15. COMMITMENTS AND CONTINGENCIES

On June 10, 2015, Alnylam filed a complaint against the Company in the Superior Court of Middlesex County, Massachusetts. The complaint alleged misappropriation of confidential, proprietary, and trade secret information, as well as other related claims, in connection with the Company's hiring of a number of former employees of Merck & Co., Inc. ("Merck") and its discussions with Merck regarding the acquisition of its subsidiary, Sirna Therapeutics, Inc., which was subsequently acquired by Alnylam.

On April 18, 2018, the Company and Alnylam entered into the Settlement Agreement, resolving all ongoing litigation between the Company and Alnylam. Pursuant to the terms of the Settlement Agreement, the Company agreed to make the following payments to Alnylam: (i) a $2.0 million upfront payment in cash, which the Company made in May 2018; (ii) an additional $13.0 million in cash to be paid as 10% of any upfront or first year cash consideration that the Company receives pursuant to future collaborations related to Ga1NAc-conjugated RNAi research and development (excluding any amounts received or to be received by the Company from its existing collaboration with BI), provided that the $13.0 million must be paid by no later than April 28, 2022; and (iii) issuance of shares of the Company's common stock pursuant to the Alnylam Share Issuance Agreement.

Under the Settlement Agreement, for periods ranging from 18 months up to four years, the Company will be restricted in its development and other activities relating to oligonucleotide-based therapeutics directed toward a defined set of eight Alnylam targets (the "Oligo Restrictions"). The Oligo Restrictions pertain to targets where Dicerna does not have, or does not currently intend to have, a therapeutic program, or are expected to be consistent with Dicerna's execution on programs in the normal course of business. The

Settlement Agreement did not include any admission of liability or wrongdoing by either party or any licenses to any intellectual property from either party.

On April 20, 2018, the Company and Alnylam entered into the Alnylam Share Issuance Agreement, pursuant to which the Company agreed to issue to Alnylam 983,208 shares in satisfaction of the Company's obligation under the Settlement Agreement to deliver shares to Alnylam. The 983,208 shares issued pursuant to the Alnylam Share Issuance Agreement was recorded at fair market value of $10.3 million based on the Company's closing share price on April 18, 2018, the date the Settlement Agreement was executed. The Company did not assign any value to the Oligo Restrictions as the Company did not incur additional losses or give up any value as a result of the restrictions.

In May 2018, the Company recorded the cash obligation of $13.0 million as a liability discounted to the estimated present value of $8.7 million at an effective interest rate of 10%. The Company applied the effective interest method, as the present value is accreted through maturity. In October 2018, the Company entered into collaboration agreements with Alexion and Lilly, under which the Company was entitled to upfront cash consideration of $22.0 million and $100.0 million, respectively (see Note 8). Accordingly, the Company revised its estimate of the present value of the litigation settlement payable from $8.7 million to $13.0 million based on the expected timing of the remaining payments. The impact of revising the expected timing of repayment was recorded as a $3.7 million charge to litigation expense in the consolidated statement of operations for the year ended December 31, 2018.

In connection with the execution of the Alexion Collaboration Agreement and the related receipt of the non-refundable upfront payment of $22.0 million and proceeds of $15.0 million from the Alexion Share Issuance Agreement in October 2018, the Company determined that $2.5 million became payable to Alnylam under the terms of the Settlement Agreement. The Company issued a payment to Alnylam of $2.5 million in November 2018 for the amount of the litigation settlement payable due in connection with the cash consideration received from Alexion during 2018.

At December 31, 2018, the outstanding balance of the litigation settlement payable was 10.5 million. The Company paid the remaining outstanding balance of litigation settlement payable in full on January 22, 2019 upon receipt of the upfront cash payment associated with the Lilly Collaboration Agreement. During the year ended December 31, 2018, the Company recognized interest expense of $0.6 million on the outstanding balance of the litigation settlement payable during the year.

Total litigation expense was $29.1 million for the year ended December 31, 2018, all of which related to the litigation and settlement agreement with Alnylam. The litigation expense for the year ended December 31, 2018 includes $24.7 million related to the Settlement Agreement. The Company recorded expenses related to the Alnylam litigation of $9.0 million during the year ended December 31, 2017.

Legal proceedings

From time to time, the Company may be subject to various claims and legal proceedings in the ordinary course of business. If the potential loss from any claim, asserted or unasserted, or legal proceeding is considered probable and the amount is reasonably estimable, the Company will accrue a liability for the estimated loss. There were no contingent liabilities recorded as of December 31, 2019 or 2018.

16. QUARTERLY FINANCIAL DATA (UNAUDITED)

The following tables contain selected quarterly financial information for the years ended December 31, 2019 and 2018.

	2019			
	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
Revenue	$ 3,107	$ 5,682	$ 8,035	$ 7,080
Net loss	$ (26,154)	$ (23,845)	$ (30,790)	$ (39,670)
Net loss per share – basic and diluted	$ (0.38)	$ (0.35)	$ (0.45)	$ (0.58)

	2018			
	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
Revenue	$ 1,545	$ 1,545	$ 1,545	$ 1,541
Net loss	$ (15,579)	$ (35,644)	$ (19,020)	$ (18,610)
Net loss per share – basic and diluted	$ (0.30)	$ (0.68)	$ (0.35)	$ (0.29)

Net loss per share is based on each reporting period's weighted-average number of shares outstanding, which may differ on a quarter-to-quarter basis. As such, the sum of the quarterly net loss per share calculations may not equal the year-to-date net loss per share calculation.

17. SUBSEQUENT EVENTS

Leases

Additional Lexington Facility

On January 14, 2020, the Company entered into a non-cancelable real property lease agreement for 61,282 square feet of laboratory and office space in Lexington, Massachusetts.

The original term is estimated to commence during the fourth quarter of 2020 and is for 125 months with options to extend the term for two additional successive periods of five years thereafter. The aggregate total fixed rent is approximately $41.8 million with the annual fixed rental payments escalating from $3.6 million to $4.8 million during the original term. The Company is also obligated to deliver an irrevocable letter of credit or security deposit in the amount of $1.5 million.

Boulder Facility Expansion

On February 4, 2020, the Company entered into an amendment to a real property lease agreement for our office location in Boulder, Colorado. The amendment provides for the lease of an additional 6,985 square feet of office space in that same location. In addition, the existing lease was amended to require an additional letter of credit for $0.1 million, totaling $0.5 million for the first 36 months of the lease and $0.4 million thereafter for the Boulder facility.

The original term of the lease is estimated to run concurrently with the original lease in this location to commence in the second quarter of 2020 for a period of 87 months from the commencement date. The Company has the option to extend the term for two additional successive periods of five years thereafter. The aggregate total fixed rent for the additional space is approximately $1.4 million with the annual fixed rental payments escalating each year but approximating $0.2 million for each annual period.

In addition to the fixed rent during the lease term, the Company will be responsible for certain customary operating expenses and real estate taxes specified in the agreement.

Institutional Investment

On February 6, 2020, the Company issued and sold an aggregate of approximately $40.0 million of shares of its common stock to a single institutional investor pursuant to its common stock Sales Agreement with Cowen and Company, LLC as the sales agent. In this transaction, the Company sold an aggregate of 2,077,500 shares of common stock at a price of $19.25 per share, resulting in net proceeds of approximately $39.2 million after a deduction of approximately $0.8 million in sales commissions. The shares in the offering were sold pursuant to a shelf registration statement declared effective by the SEC on May 31, 2018 and a prospectus supplement filed with the SEC on June 1, 2018.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE

None.

ITEM 9A. CONTROLS AND PROCEDURES

Disclosure Controls and Procedures

We maintain disclosure controls and procedures that are designed to ensure that information required to be disclosed in our periodic and current reports that we file under the Exchange Act, with the SEC is recorded, processed, summarized and reported within the time periods specified in the SEC's rules and forms, and that such information is accumulated and communicated to our management, including our chief executive officer and principal financial officer, as appropriate, to allow timely decisions regarding required disclosure.

As of the end of the period covered by this Annual Report on Form 10-K, we carried out an evaluation, under the supervision and with the participation of our management, including the chief executive officer and the chief financial officer, of the effectiveness of the design and operation of our disclosure controls and procedures pursuant to Exchange Act Rule 13a-15. Based upon, and as of the date of, this evaluation, our chief executive officer and our chief financial officer concluded that our disclosure controls and

procedures were effective. Accordingly, management believes that the financial statements included in this report fairly present in all material respects our financial condition, results of operations and cash flows for the periods presented.

Management's Annual Report on Internal Control Over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting (as defined in Rules 13a-15(f) and 15d-15(f) of the Exchange Act). Under the supervision and with the participation of our management, including our chief executive officer and chief financial officer, we conducted an evaluation of the effectiveness of our internal control over financial reporting as of December 31, 2019 based on the guidelines established in Internal Control—Integrated Framework 2013 issued by the Committee of Sponsoring Organizations of the Treadway Commission. Our internal control over financial reporting includes policies and procedures that provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external reporting purposes in accordance with U.S. generally accepted accounting principles.

Based on that evaluation, management concluded that our internal control over financial reporting was effective as of December 31, 2019.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

The Company's financial statements included in this Annual Report on Form 10-K have been audited by Deloitte & Touche LLP, independent registered public accounting firm, as indicated in the following report. Deloitte & Touche LLP has also provided an attestation report on the Company's internal control over financial reporting.

Report of Independent Registered Public Accounting Firm

To the Board of Directors and Stockholders of Dicerna Pharmaceuticals, Inc.

Opinion on Internal Control Over Financial Reporting

We have audited the internal control over financial reporting of Dicerna Pharmaceuticals, Inc. and subsidiaries (the "Company") as of December 31, 2019, based on criteria established in *Internal Control – Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). In our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control – Integrated Framework (2013)* issued by COSO.

We have also audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated financial statements as of and for the year ended December 31, 2019, of the Company and our report dated February 27, 2020, expressed an unqualified opinion on those financial statements.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying Management's Annual Report on Internal Control over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects. Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assess risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ Deloitte & Touche LLP

Boston, Massachusetts

February 27, 2020

Changes in Internal Control Over Financial Reporting

We continuously seek to improve the efficiency and effectiveness of our internal controls. This results in refinements to processes throughout the Company. There was no change in our internal control over financial reporting during the year ended December 31, 2019, which was identified in connection with our management's evaluation required by Exchange Act Rules 13a-15(f) and 15d-15(f), that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Inherent Limitations on the Effectiveness of Controls

Our management, including the chief executive officer and chief financial officer, does not expect that our disclosure controls and procedures or our internal control over financial reporting will prevent all error and all fraud. A control system, no matter how well conceived and operated, can provide only reasonable, not absolute, assurance that the objectives of the control system are met. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud, if any, within a company have been detected. These inherent limitations include the realities that judgments in decision making can be faulty and that breakdowns can occur because of simple error or mistake. Additionally, controls can be circumvented by the individual acts of some persons, by collusion of two or more people or by management override of the control. The design of any system of controls also is based in part upon certain assumptions about the likelihood of future events, and there can be no assurance that any design will succeed in achieving its stated goals under all potential future conditions. Over time, controls may become inadequate because of changes in conditions, or the degree of compliance with the policies or procedures may

deteriorate. Because of the inherent limitations in a cost-effective control system, misstatements due to error or fraud may occur and not be detected.

ITEM 9B. OTHER INFORMATION

In connection with our annual review of our compensation and employment arrangements with our executives and other members of our leadership team, we adopted new forms of employment agreements to be entered into with such individuals that we may hire in the future, and amended and/or restated forms of employment agreements with such individuals currently serving in such capacities, including with Douglas M. Fambrough, III, our chief executive officer, Bob D. Brown, our chief scientific officer and executive vice president, and John B. Green, our chief financial officer, each of whom was a named executive officer for 2018. The material terms of such agreements are described in further detail below.

Douglas M. Fambrough, III, Ph.D. In July 2016, we entered into an amended and restated employment agreement with Dr. Fambrough and on February 27, 2020, we entered into an amendment to the Fambrough Agreement (as amended, the "Fambrough Agreement") providing for, among other things, the clarification that acceleration of Dr. Fambrough's equity contained in his existing agreement will apply to time-based stock-based awards. Dr. Fambrough's current annual base salary is $575,000 and he will be eligible to participate in the Company's annual bonus program, with a target opportunity equal to 60% of his base salary. Pursuant to the Fambrough Agreement, Dr. Fambrough's employment with us is "at-will," and his employment is not for a specified term. The Fambrough Agreement also provides that Dr. Fambrough is eligible to participate in our benefit programs made available to our senior executives generally.

Under the Fambrough Agreement, if Dr. Fambrough's employment is terminated by us other than for "cause" (as such term is defined in the Fambrough Agreement), if we terminate his employment due to his "disability" (as such term is defined in the Fambrough Agreement), or by him for "good reason" (as such term is defined in the Fambrough Agreement), Dr. Fambrough will receive the following severance benefits: (i) 18 months of continued base salary payments; (ii) a pro rata portion of his annual bonus for the year in which the termination occurs, based on actual performance during the entire performance period; (iii) up to 18 months of Company-reimbursed Consolidated Omnibus Budget Reconciliation Act ("COBRA") premiums; and (iv) outstanding and unvested time-based stock-based awards that were scheduled to vest in the 12-month period following his termination of employment will accelerate in full.

In addition, if we terminate Dr. Fambrough other than for cause, if we terminate his employment due to his "disability" or if Dr. Fambrough terminates his employment for good reason during the one-year period following a change of control (as defined in the Fambrough Agreement), then Dr. Fambrough will receive the following severance benefits: (i) a lump sum severance payment equal to 1.5, multiplied by the sum of Dr. Fambrough's annual base salary and target annual bonus; (ii) a pro rata portion of Dr. Fambrough's target bonus for the year in which the termination occurs; (iii) up to 18 months of Company-reimbursed COBRA premiums; and (iv) outstanding and unvested time-based stock-based awards will accelerate in full. Under the terms of the Fambrough Agreement, if any payment or other benefit provided to Dr. Fambrough pursuant to the Fambrough Agreement constitutes an "excess parachute payment" within the meaning of Section 280G of the Internal Revenue Code of 1986, as amended (the "Code"), and would be subject to an excise tax imposed by Section 4999 of the Code, then the amounts actually paid to Dr. Fambrough will be reduced to the extent that such a reduction would result in Dr. Fambrough receiving a greater amount than he would have received if the payment had been made in full.

Dr. Fambrough's right to receive these severance benefits is subject to his providing a release of claims in favor of us. Dr. Fambrough has also entered into an agreement that includes noncompetition and nonsolicitation covenants in favor of us that apply during Dr. Fambrough's employment with us and for two years thereafter.

Bob D. Brown, Ph.D. and John B. Green On February 27, 2020, we entered into amended and restated employment agreements with each of Bob D. Brown, our Chief Scientific Officer, Executive Vice President, and John B. Green, our Chief Financial Officer, each a named executive officer for 2018 (collectively, "Employment Agreements"). These amended and restated employment agreements provide for, among other things, the clarification that acceleration of these executives' equity contained in their existing agreements will apply to time-based stock-based awards. Per the Employment Agreements, their employment with us is "at-will," and not for a specified term. Under the Employment Agreements, Mr. Green's and Dr. Brown's current annual base salaries are $415,800 and $480,041, respectively, and each are eligible to participate in the Company's annual bonus program, with a target opportunity equal to 40% of base salary. The Employment Agreements also provide that each executive is eligible to participate in our benefit programs made available to our senior executives generally.

Pursuant to the respective Employment Agreements, if we terminate the executive other than for "cause" (as defined in the respective Employment Agreement), if we terminate the executive's employment due to the executive's "disability" (as defined in the relevant employment agreement), or if the executive officer terminates his employment for "good reason" (as defined in the respective Employment Agreement), then the executive will receive the following severance benefits: (i) 12 months of continued base salary payments; (ii) a pro rata portion of his annual bonus for the year in which the termination occurs, based on actual performance during the entire performance period; and (iii) up to 12 months of Company-reimbursed COBRA premiums.

In addition, if we terminate the executive other than for cause, if we terminate the executive's employment due to the executive's disability, or if the executive terminates his employment for good reason during the one-year period following a change of control (as defined in the respective Employment Agreement), then the executive officer will receive the following severance benefits: (i) a lump sum severance payment equal to the sum of the executive's annual base salary and target annual bonus; (ii) a pro rata portion of the executive's target bonus for the year in which the termination occurs; and (iii) up to 12 months of Company-reimbursed COBRA premiums. Except as otherwise provided for in an award agreement, any outstanding and unvested time-based stock-based awards will vest in full upon a change in control of the Company. Under the terms of the Employment Agreements, if any payment or other benefit provided to the executive pursuant to his Employment Agreement constitutes an "excess parachute payment" within the meaning of Section 280G of the Code, and would be subject to an excise tax imposed by Section 4999 of the Code, then the amounts actually paid to the executive officer will be reduced to the extent that such a reduction would result in the executive officer receiving a greater amount than he would have received if the payment had been made in full.

Each executive's right to receive the aforementioned severance benefits is subject to him providing a release of claims in favor of us. Each of Mr. Green and Dr. Brown has also entered into an agreement that includes noncompetition and nonsolicitation covenants in favor of us that apply during each of these employee's employment with us and for two years thereafter.

In addition, on February 24, 2020, Mr. Green notified us of his intention to retire from his position as chief financial officer of our company. On February 27, 2020, we entered into a transition agreement (the "Transition Agreement") with Mr. Green to provide for, among other things, arrangements in relation to the departure of Mr. Green from our company. The material terms of such agreement are described in further detail below.

Transition agreement. Pursuant to the Transition Agreement, we will continue Mr. Green's employment as our chief financial officer through the date of commencement of employment by his successor (the "Transition Period"), for whom we are engaged in a search, as of the date of this Current Report on Form 8-K. During Transition Period, in which Mr. Green will continue his employment (ending no later than June 30, 2021), Mr. Green will continue to be paid his current base salary of $415,800 per year and the other terms of his employment agreement (other than as modified by the Transition Agreement) will continue in effect. Mr. Green is also entitled to receive a bonus payment, with a target annual bonus of 40% of his base salary, subject to the determination of the final amount in the sole discretion of our board of directors, as if Mr. Green had remained an employee for the full calendar year 2020, and based on our corporate goal achievements, as determined by our board of directors. Such bonus payment is in lieu of any bonus or incentive compensation payments otherwise due to Mr. Green pursuant to his existing employment agreement. At the conclusion of the Transition Period, Mr. Green will be entitled to the following severance benefits (in lieu of the severance benefits described in his employment agreement): (i) 12 months of continued base salary payments; and (ii) up to 12 months of Company-reimbursed COBRA premiums.

Following the Transition Period, we will retain Mr. Green as a consultant until June 30, 2021, or such earlier or later date consistent with the Transition Agreement (the "Consulting Period"), in order to provide consulting services that may consist of any transitional assistance, any responsibilities of a chief financial officer or any other responsibilities that we may reasonably request. Mr. Green's services during the Consulting Period will constitute a continued service relationship with us and, as a result, his equity awards will continue to vest until the end of the Consulting Period, following which, Mr. Green will have three months to exercise any vested awards pursuant to the terms of such awards (but no later than the expiration date of the awards). In the event that we enter into a term sheet or letter of intent or similar agreement with a potential acquirer contemplating a change of control, then upon the consummation of the change of control, all time-based equity awards held by Mr. Green will immediately accelerate and become fully exercisable or non-forfeitable upon the consummation of the change of control.

The foregoing description of the terms of the employment agreements and the transition agreement does not purport to be complete and is qualified in its entirety by reference to the full text of such agreements, copies of which are filed as exhibits to this Annual Report on Form 10-K.

PART III

ITEM 10. DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE

The information required by this item and not set forth below will be set forth in the definitive proxy statement (the "Proxy Statement") for our 2020 Annual Meeting of Stockholders to be filed with the SEC pursuant to Regulation 14A not later than 120 days after the end of the fiscal year covered by this Annual Report on Form 10-K, and is incorporated herein by reference.

Information regarding our audit committee financial expert will be set forth in the Proxy Statement and is incorporated herein by reference.

We have adopted a Code of Business Conduct and Ethics applicable to all employees, including the principal executive officer, principal financial officer, and principal accounting officer, or persons performing similar functions. The Code of Business Conduct and Ethics is posted on our website at www.dicerna.com. Amendments to, and waivers from, the Code of Business Conduct and Ethics that apply to any of these officers, or persons performing similar functions, and that relate to any element of the code of ethics definition enumerated in Item 406(b) of Regulation S-K will be disclosed at the website address provided above and, to the extent required by applicable regulations, on a Current Report on Form 8-K.

ITEM 11. EXECUTIVE COMPENSATION

The information required by this item will be set forth in the Proxy Statement and is incorporated herein by reference.

ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS

The information required by this item will be set forth in the Proxy Statement and is incorporated herein by reference.

ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS

The information required by this item will be set forth in the Proxy Statement and is incorporated herein by reference.

ITEM 14. PRINCIPAL ACCOUNTANT FEES AND SERVICES

The information required by this item will be set forth in the Proxy Statement and is incorporated herein by reference.

PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES

(1) *Consolidated Financial Statements:*

The following consolidated financial statements are filed as part of this Annual Report on Form 10-K under Item 8 – "Financial Statements and Supplementary Data."

(2) *Financial Statement Schedules.*

All schedules are omitted because they are not applicable, not required, or because the required information is included in the consolidated financial statements or notes thereto.

(3) *Exhibits.*

EXHIBIT INDEX

Exhibit Number	Description of Documents	Incorporated by Reference			
		Form	File Number	Exhibit	Filing Date
3.1	Amended and Restated Certificate of Incorporation of the Company.	8-K	001-36281	3.1	February 5, 2014
3.2	Amended and Restated Bylaws of the Company.	8-K	001-36281	3.2	February 5, 2014
3.3	Certificate of Designation of Redeemable Convertible Preferred Stock.	8-K	001-36281	3.1	March 30, 2017
3.4	Certificate of Elimination of the Redeemable Convertible Preferred Stock, dated as of December 29, 2017.	8-K	001-36281	3.1	December 29, 2017
4.1*	Description of Securities Registered Pursuant to Section 12 of the Securities Exchange Act of 1934, as amended.				
4.2	Specimen Common Stock Certificate.	S-1	333-193150	4.1	January 28, 2014
4.2A	Form of Redeemable Convertible Preferred Stock Certificate.	8-K	001-36281	4.1	March 30, 2017
4.3	Form of Warrant to Purchase Common Stock.	S-1	333-193150	4.2	December 31, 2013
4.4	Form of Warrant to Purchase Preferred Stock.	S-1	333-193150	4.3	December 31, 2013
4.5	Form of Amended and Restated Registration Rights Agreement.	8-K	001-36281	10.2	March 30, 2017
4.5A	Form of First Amendment to Registration Rights Agreement.	8-K	001-36281	10.1	December 18, 2017
10.1+	2007 Employee, Director and Consultant Stock Plan, as amended (the "2007 Plan").	S-1	333-193150	10.1	December 31, 2013
10.2+	Form of Restricted Stock Agreement under the 2007 Plan.	S-1	333-193150	10.2	December 31, 2013
10.3+	Form of Incentive Stock Option Agreement under the 2007 Plan.	S-1	333-193150	10.3	December 31, 2013
10.4+	Form of Non-Qualified Stock Option Agreement under the 2007 Plan.	S-1	333-193150	10.4	December 31, 2013
10.5+	2010 Employee, Director and Consultant Equity Incentive Plan, as amended (the "2010 Plan").	S-1	333-193150	10.5	December 31, 2013
10.6+	Form of Stock Option Grant Notice and Stock Option Agreement under the 2010 Plan.	S-1	333-193150	10.6	December 31, 2013
10.7+	Form of Restricted Stock Agreement under the 2010 Plan.	S-1	333-193150	10.7	December 31, 2013
10.8+	2014 Employee Stock Purchase Plan.	S-1	333-193150	10.9	January 28, 2014
10.9+	Form of Indemnification Agreement by and between the Company and each of its directors.	S-1	333-193150	10.10	January 28, 2014
10.10+	Letter agreement dated as of June 2, 2009, by and between the Company and David M. Madden.	S-1	333-193150	10.14	December 31, 2013
10.11+	Letter agreement dated as of February 28, 2011, by and between the Company and Dennis H. Langer M.D., J.D.	S-1	333-193150	10.15	December 31, 2013
10.12	Lease agreement dated as of July 11, 2014, by and between the Company and King 87 CPD LLC.	10-Q	001-36281	10.5	November 6, 2014

Exhibit Number	Description of Documents	Incorporated by Reference			
		Form	File Number	Exhibit	Filing Date
10.13+	Letter Agreement dated as of September 12, 2014, by and between the Company and Bruce Peacock.	10-K	001-36281	10.26	March 12, 2015
10.14	Sales Agreement, dated as of March 12, 2015, between the Registrant and Cowen and Company, LLC.	S-3	333-202687	1.2	March 12, 2015
10.15+	Amended and Restated 2014 Performance Incentive Plan, as amended and restated on May 7, 2019.	10-Q	001-36281	10.2	May 10, 2019
10.16+	Form of Incentive Stock Option Agreement under the Amended and Restated 2014 Performance Incentive Plan.	10-K	001-36281	10.31	March 10, 2016
10.17+	Form of Non-Qualified Stock Option Agreement under the Amended and Restated 2014 Performance Incentive Plan.	10-K	001-36281	10.32	March 10, 2016
10.18+	Form of Restricted Stock Unit Award Agreement under the Amended and Restated 2014 Performance Incentive Plan.	8-K	001-36281	10.1	January 13, 2020
10.19+	Form of Restricted Stock Unit Grant Notice under the Amended and Restated 2014 Performance Incentive Plan.	8-K	001-36281	10.2	January 13, 2020
10.20+	Separation Agreement dated as of December 15, 2015 by and between the Company and James E. Dentzer.	10-K	001-36281	10.33	March 10, 2016
10.21+	Offer Letter dated as of January 14, 2016 by and between the Company and John “Jack” Green.	10-K	001-36281	10.34	March 10, 2016
10.22+	Dicerna Pharmaceuticals, Inc. 2016 Inducement Plan, as amended.	S-8	333-223648	4.3	March 14, 2018
10.23+	Form of Dicerna Pharmaceuticals, Inc. Non-Qualified Inducement Stock Option Agreement.	S-8	333-210071	4.2	March 10, 2016
10.24+	Form of Non-Plan Inducement Stock Option Agreement.	S-8	333-210071	4.4	March 10, 2016
10.25+	Amended and Restated Employment Agreement dated as of July 8, 2016 by and between the Company and Douglas M. Fambrough, III.	10-Q	001-36281	10.1	November 7, 2016
10.26+	Amended and Restated Employment Agreement dated as of July 8, 2016 by and between the Company and Bob. D. Brown.	10-Q	001-36281	10.2	November 7, 2016
10.27+	Amended and Restated Employment Agreement dated as of July 6, 2016 by and between the Company and James B. Weissman.	10-Q	001-36281	10.3	November 7, 2016
10.28+	Amended and Restated Employment Agreement dated as of November 4, 2016 by and between the Company and John B. Green.	10-Q	001-36281	10.4	November 7, 2016
10.29*+	Amended and Restated Employment Agreement dated as of February 25, 2020 by and between the Company and John B. Green.				
10.30*+	Amended and Restated Employment Agreement dated as of February 24, 2020 by and between the Company and James B. Weissman.				
10.31*+	Amended and Restated Employment Agreement dated as of February 21, 2020 by and between the Company and Bob. D. Brown.				
10.32*+	Amended and Restated Employment Agreement dated as of February 21, 2020 by and between the Company and Douglas M. Fambrough, III.				
10.33*+	Amended and Restated Employment Agreement dated as of February 26, 2020 by and between the Company and Ralf Rosskamp.				
10.34	Form of Letter Agreement by and between the Company and Adam Koppel.	8-K	001-36281	10.3	March 30, 2017
10.35	Form of Redeemable Convertible Preferred Stock Purchase Agreement by and among the Company and seven institutional investors led by funds advised by Bain Capital Life Sciences L.P.	8-K	001-36281	10.1	March 30, 2017
10.36+	Employment Agreement, dated May 18, 2017, by and between the Company and Ralf Rosskamp.	10-Q	001-36281	10.3	August 10, 2017
10.37	Collaborative Research and License Agreement, dated October 27, 2017, by and between the Company and Boehringer Ingelheim International GmbH.	10-K	001-36281	10.30	March 8, 2018
10.38	Letter Agreement entered into on December 13, 2017 by and between the Company and the holders of its redeemable convertible preferred stock.	8-K	001-36281	10.1	December 14, 2017
10.39†	Confidential Settlement Agreement and General Release, dated April 18, 2018, between the Company and Alnylam Pharmaceuticals, Inc.	10-Q	001-36281	10.1	August 8, 2018
10.40	Share Issuance Agreement, dated April 20, 2018, between the Company and Alnylam Pharmaceuticals, Inc.	10-Q	001-36281	10.2	August 8, 2018
10.41†	Collaborative Research and License Agreement, dated October 22, 2018, by and between the Company and Alexion Pharma Holding Unlimited Company.	10-K	001-36281	10.34	March 13, 2019
10.42	Alexion Share Issuance Agreement, dated October 22, 2018, by and between the Company and Alexion Pharma Holding Unlimited Company.	10-K	001-36281	10.35	March 13, 2019
10.43†	Collaboration and License Agreement, dated October 25, 2018, by and between the Company and Eli Lilly and Company.	10-K	001-36281	10.36	March 13, 2019
10.44	Lilly Share Issuance Agreement, dated October 25, 2018, by and between the Company and Eli Lilly and Company.	10-K	001-36281	10.37	March 13, 2019
10.45†	Additional Target Agreement, dated December 31, 2018, by and between the Company and Boehringer Ingelheim International GmbH.	10-K	001-36281	10.38	March 13, 2019

Exhibit Number	Description of Documents	Incorporated by Reference			
		Form	File Number	Exhibit	Filing Date
10.46*††	Collaboration and License Agreement, dated October 30, 2019, by and between the Company, F. Hoffman-La Roche Ltd and Hoffman-La Roche Inc.				
10.47*††	Collaboration and License Agreement, dated November 15, 2019, by and between the Company and Novo Nordisk A/S.				
10.48*	Share Issuance Agreement, dated November 15, 2019, by and between the Company and Novo Nordisk A/S.				
10.49	Lease Agreement between the Company and Hayden Office Trust, dated as of January 2, 2019.	10-Q	001-36281	10.1	May 10, 2019
10.50	First Amendment to Lease Agreement between the Company and Hayden Office Trust, dated as of March 6, 2019.	10-Q	001-36281	10.1.1	May 10, 2019
10.51	Lease Agreement between the Company and Western Office Portfolio Property Owner LLC, dated as of August 26, 2019.	10-Q	001-36281	10.1	November 11, 2019
10.52*	First Amendment to Lease Agreement between the Company and Western Office Portfolio Property Owner LLC, dated as of February 4, 2020.				
10.53*	Lease Agreement between the Company and HCP/King 75 Hayden LLC, dated as of January 14, 2020.				
10.54*+	Employment Agreement dated as of June 19, 2019, by and between the Company and Robert Ciappenelli.				
10.55*+	Amended and Restated Employment Agreement dated as of February 21, 2020, by and between the Company and Robert Ciappenelli.				
10.56*+	Transition Agreement dated as of February 27, 2020, by and between the Company and John B. Green.				
21.1*	Subsidiaries of the Company.				
23.1*	Consent of Independent Registered Accounting Firm.				
24	Power of Attorney (reference is made to the signature page).				
31.1*	Certification of the Company's principal executive officer required by Rule 13a-14(a) or Rule 15d-14(a).				
31.2*	Certification of the Company's principal financial officer required by Rule 13a-14(a) or Rule 15d-14(a).				
32.1**	Section 1350 Certifications.				
101.INS*	XBRL Report Instance Document				
101.SCH*	XBRL Taxonomy Extension Schema Document				
101.CAL*	XBRL Taxonomy Calculation Linkbase Document				
101.LAB*	XBRL Taxonomy Label Linkbase Document				
101.PRE*	XBRL Taxonomy Presentation Linkbase Document				
101.DEF*	XBRL Taxonomy Extension Definition Linkbase Document				

† Confidential treatment with respect to specific portions of this Exhibit has been requested, and such portions are omitted and have been filed separately with the Securities and Exchange Commission.
†† Portions of this exhibit (indicated by asterisks) have been omitted in accordance with the rules of the Securities and Exchange Commission.
+ Management contract or compensatory plan or arrangement.
* Filed herewith.
** Exhibit 32.1 is being furnished and shall not be deemed to be "filed" for purposes of Section 18 of the Exchange Act, or otherwise subject to the liability of that section, nor shall such exhibit be deemed to be incorporated by reference in any registration statement or other document filed under the Securities Act, or the Exchange Act, except as otherwise stated in such filing.

ITEM 16. FORM 10-K SUMMARY

None.

SIGNATURES

Pursuant to the Securities Exchange Act of 1934, the Registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized, in Lexington, Commonwealth of Massachusetts on February 27, 2020.

By: /s/ Douglas M. Fambrough, III

Douglas M. Fambrough, III, Ph.D.
Chief Executive Officer and Director
(Principal Executive Officer)

By: /s/ John B. Green

John B. Green
Chief Financial Officer (Principal Financial Officer and Principal Accounting Officer)

POWER OF ATTORNEY

KNOW ALL PERSON BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Douglas M. Fambrough, III, Ph.D. and John B. Green and each of them, as his true and lawful attorneys-in-fact and agents, with full power of substitution and resubstitution, for him and in his name, place and stead, in any and all capacities, to sign any and all amendments to this Annual Report on Form 10-K and to file the same, with all exhibits thereto and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents and each of them, full power and authority to do and perform each and every act and thing requisite and necessary to be done in connection therewith, as fully to all intents and purposes as he might or could do in person, hereby ratifying and confirming all that said attorneys-in-fact and agents, or any of them, or their or his substitute or substitutes, may lawfully do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Exchange Act of 1934, as amended, this report has been signed by the following persons in the capacities and on the dates indicated:

Signature	Title	Date
/s/ Douglas M. Fambrough, III **Douglas M. Fambrough, III, Ph.D.**	Chief Executive Officer and Director (Principal Executive Officer)	February 27, 2020
/s/ John B. Green **John B. Green**	Chief Financial Officer (Principal Financial Officer and Principal Accounting Officer)	February 27, 2020
/s/ J. Kevin Buchi **J. Kevin Buchi**	Chairman	February 27, 2020
/s/ Stephen Doberstein **Stephen Doberstein, Ph.D.**	Director	February 27, 2020
/s/ Martin Freed **Martin Freed, M.D.**	Director	February 27, 2020
/s/ Patrick Gray **Patrick Gray**	Director	February 27, 2020
/s/ Stephen J. Hoffman **Stephen J. Hoffman, MD., Ph.D.**	Director	February 27, 2020
/s/ Adam M. Koppel **Adam M. Koppel, M.D., Ph.D.**	Director	February 27, 2020
/s/ Marc Kozin **Marc Kozin**	Director	February 27, 2020
/s/ Anna Protopapas **Anna Protopapas**	Director	February 27, 2020
/s/ Cynthia Smith **Cynthia Smith**	Director	February 27, 2020

Exhibit 4.1

Description of the Registrant's Securities Registered Pursuant to Section 12 of the Securities Exchange Act of 1934, as amended

The summary of the general terms and provisions of the registered securities of Dicerna Pharmaceuticals, Inc. ("Dicerna," "we," or "our") set forth below does not purport to be complete and is subject to and qualified in its entirety by reference to our Restated Certificate of Incorporation, as amended (our "certificate of incorporation") and our Amended and Restated By-laws (our "by-laws" and, together with our certificate of incorporation, our "Charter Documents"), each of which is incorporated by reference as an exhibit to our most recent Annual Report on Form 10-K filed with the Securities and Exchange Commission. We encourage you to read our Charter Documents and the applicable provisions of the General Corporation Law of the State of Delaware (the "DGCL") for additional information.

General

Our authorized capital stock consists of 150,000,000 shares of common stock, par value $0.0001 per share, and 5,000,000 shares of preferred stock, par value $0.0001 per share.

Common Stock

Dividends

Holders of our common stock are entitled to receive dividends ratably, if any, as may be declared by our board of directors out of legally available funds, subject to any preferential dividend rights of any preferred stock then outstanding.

Voting

Holders of our common stock are entitled to one vote for each share of common stock held of record for the election of directors and on all matters submitted to a vote of stockholders. In the election of directors, a majority of the votes cast at a meeting of stockholders is sufficient to elect a director, except that if the number of nominees exceeds the number of directors to be elected, then a plurality of the votes cast at a meeting of stockholders is sufficient to elect a director. Our stockholders do not have cumulative voting rights in the election of directors. Accordingly, holders of a majority of the voting shares are able to elect all of the directors.

With the exception of certain anti-takeover provisions as detailed in Delaware Law and Our Charter Documents, a majority vote of common stockholders is generally required to take action under our certificate of incorporation and bylaws.

Other Rights

Upon our dissolution, liquidation or winding up, holders of our common stock are entitled to share ratably in our net assets legally available after the payment of all our debts and other liabilities, subject to the preferential rights of any preferred stock then outstanding. Holders of our common stock have no preemptive, subscription or conversion rights, and there are no redemption or sinking fund provisions applicable to our common stock. There are no restrictions on the alienability of common stock. We may issue additional shares of common stock, if authorized by our board of directors, without the common stockholders' approval, unless required by Delaware law or the stock exchange on which our securities are traded. The issuance of additional shares could have the effect of diluting any earnings per share and the book value per share of outstanding shares of common stock. If we receive the appropriate payment, shares of common stock that we issue will be fully paid and nonassessable.

Preferred Stock

Our board of directors has the authority, without further action by our stockholders, to designate and issue up to 5,000,000 shares of preferred stock in one or more series. Our board of directors may also designate the rights, preferences and privileges of the holders of each such series of preferred stock, any or all of which may be greater than or senior to those granted to the holders of common stock. Though the actual effect of any such issuance on the rights of the holders of common stock will not be known until such time as our board of directors determines the specific rights of the holders of preferred stock, the potential effects of such an issuance include:

- diluting the voting power of the holders of common stock;
- reducing the likelihood that holders of common stock will receive dividend payments;
- reducing the likelihood that holders of common stock will receive payments in the event of our liquidation, dissolution, or winding up; and
- delaying, deterring or preventing a change in control or other corporate takeover.

No shares of preferred stock are outstanding as of the date of our Annual Report on Form 10-K with which this Exhibit 4.1 is filed as an exhibit.

Anti-Takeover Effects of Delaware Law and Provisions of our Charter Documents

Certain provisions of the DGCL and our Charter Documents contain provisions that could have the effect of delaying, deferring or discouraging another party from acquiring control of us. These provisions, which are summarized below, are expected to discourage certain types of coercive takeover practices and inadequate takeover bids. These provisions are also designed in part to encourage anyone seeking to acquire control of us to first negotiate with our board of directors. We believe that the advantages gained by protecting our ability to negotiate with any unsolicited and potentially unfriendly acquirer outweigh the disadvantages of discouraging such proposals, including those priced above the then-current market value of our common stock, because, among other reasons, the negotiation of such proposals could improve their terms.

Charter Document Provisions

Our Charter Documents include a number of provisions that could deter hostile takeovers or delay or prevent changes in control of our board of directors or management team, including the following:

- the ability of our Board to increase or decrease the size of the Board without stockholder approval;
- advance notice requirements for the nomination of candidates for election to our Board and for proposals to be brought before our annual meeting of stockholders;
- authorization of our Board to designate the terms of and issue new series of preferred stock without stockholder approval;
- non-cumulative voting for directors;
- establish that our board of directors is divided into three classes—Class I, Class II and Class III—with each class serving staggered terms; and
- limitations on the ability of our stockholders to call special meetings of stockholders.

Delaware Anti-Takeover Statute

We are subject to the provisions of Section 203 of the DGCL regulating corporate takeovers. In general, Section 203 prohibits a publicly held Delaware corporation from engaging, under certain circumstances, in a business combination with an interested stockholder for a period of three years following the date the person became an interested stockholder unless:

- prior to the date of the transaction, the board of directors of the corporation approved either the business combination or the transaction which resulted in the stockholder becoming an interested stockholder;
- upon completion of the transaction that resulted in the stockholder becoming an interested stockholder, the interested stockholder owned at least 85% of the voting stock of the corporation outstanding at the time the transaction commenced, excluding for purposes of determining the voting stock outstanding, but not for determining the outstanding voting stock owned by the interested stockholder, (1) shares owned by persons who are directors and also officers and (2) shares owned by employee stock plans in which employee participants do not have the right to determine confidentially whether shares held subject to the plan will be tendered in a tender or exchange offer; or
- at or subsequent to the date of the transaction, the business combination is approved by the board of directors of the corporation and authorized at an annual or special meeting of stockholders, and not by written consent, by the affirmative vote of at least 66 2/3% of the outstanding voting stock which is not owned by the interested stockholder.

Generally, a business combination includes a merger, asset or stock sale, or other transaction resulting in a financial benefit to the interested stockholder. An interested stockholder is a person who, together with affiliates and associates, owns or, within three years prior to the determination of interested stockholder status, did own 15% or more of a corporation’s outstanding voting stock. We expect the existence of this provision to have an anti-takeover effect with respect to transactions our board of directors does not approve in advance. We also anticipate that Section 203 of the DGCL may discourage business combinations or other attempts that might result in a premium over the market price for the shares of common stock held by our stockholders.

The provisions of Delaware law and our Charter Documents could have the effect of discouraging others from attempting hostile takeovers and, as a consequence, may also inhibit temporary fluctuations in the market price of

our common stock that often result from actual or rumored hostile takeover attempts. These provisions may also have the effect of preventing changes in our management. It is possible that these provisions could make it more difficult to accomplish transactions that stockholders may otherwise deem to be in their best interests.

Exhibit 10.29

EMPLOYMENT AGREEMENT (Revised)

EMPLOYMENT AGREEMENT ("Agreement") made this February 21, 2020 (the "Effective Date") between Dicerna Pharmaceuticals, Inc., a Delaware corporation ("Company"), on the one hand and John Green (the "Executive") on the other hand.

WHEREAS, the Company desires to employ the Executive and the Executive desires to be employed by the Company, on terms set forth herein;

NOW, THEREFORE, in consideration of the mutual agreements set forth herein, the parties agree as follows:

1. Term of Employment. The Executive's employment under this Agreement shall commence on the Effective Date and shall end on such date as the Executive's employment terminates in accordance with Section 4 of this Agreement. Subject to the balance of this Agreement, the Executive shall be an at-will employee of the Company whose employment may be terminated (by the Company or by the Executive) at any time, for any or no reason, in which case the Executive will be entitled to the separation benefits set forth in Section 4, below.

2. Duties. During his employment with the Company, the Executive shall have the title of Chief Financial Officer. The Executive shall devote his full business time and effort to the performance of his duties for the Company, which he shall perform faithfully and to the best of his ability. The Executive shall have all of the customary powers and duties associated with his position and shall be subject to the Company's policies, procedures, and approval practices, as generally in effect from time to time for all senior executives of the Company and the direction and oversight of the Board. The Executive will report directly to the Chief Executive Officer of the Company.

3. Compensation and Related Matters.

a. Base Salary. The Company shall pay the Executive base salary at a rate of $17,708 paid twice monthly (which annualizes to $425,000), less withholdings and deductions required and/or permitted by law. The Executive's base salary shall be paid in conformity with the Company's payroll practices generally applicable to the Company's senior executives.

b. Annual Bonus.
The Executive shall be eligible to be considered for an Annual Bonus upon achieving of certain pre-determined performance targets consistent with any Incentive Compensation Plan established by the Compensation Committee (the "Committee"). The Annual Bonus shall be based, in part, on the Executive's performance. The grant of such a bonus shall be in the sole discretion of the Committee. The maximum bonus amount for which the Executive will be eligible is forty percent (40%)of base salary earned for the calendar year, provided that, the Annual Bonus for the first year of employment shall be prorated based on the date of hire. The Annual Bonus will be earned only after it has been granted by the Committee. The Annual Bonus shall be paid to the Executive following the close of the fiscal year to which it relates, in no event later than March 15th of the calendar year immediately following the calendar year in which it was earned. The Executive must be actively employed by the Company at the time the Committee considers granting of bonuses to be eligible to receive such bonus.

c. Equity Compensation. Subject to approval of the Board or an appropriate committee thereof, Executive shall be eligible for equity compensation awards, in such amounts and subject to such terms as shall be commensurate with awards granted to other senior executives of the Company.

d. Benefits. During his employment with the Company, the Executive shall be entitled to participate in all
employee benefit plans and programs, including paid sick leave and holidays, life insurance, disability, medical, dental, and retirement savings plans, to the same extent generally available to senior executives of the Company, in accordance with the terms of those plans and programs. The Executive shall be permitted up to four weeks of paid vacation per year, which will accrue on a monthly basis. The Executive will not be allowed to accumulate more than three weeks of unused vacation days at any given time. The Executive may carry over a maximum of ten unused vacation days from one calendar year to the next.

e. Expenses. The Company agrees to reimburse the Executive for reasonable out-of-pocket expenses incurred in connection with Company business and within standards to be established by the Board from time to time, including, without limitation, travel and accommodations for authorized business trips, provided vouchers therefor, or other supporting information as the Company may reasonably require, are presented to the Company. All reimbursements provided under this Agreement shall be made or provided in accordance with the requirements of Section 409A of the Internal Revenue Code of 1986, as amended (the "Code") and the rules and regulations thereunder ("Section 409A") including, where applicable, the requirement that (i) any reimbursement is for expenses incurred during the Executive's lifetime (or during a shorter period of time specified in this Agreement); (ii) the amount of expenses eligible for reimbursement during a calendar year may not affect the expenses eligible for reimbursement in any other calendar year; (iii) the reimbursement of an eligible expense shall be made no later than the last day of the calendar year following the year in which the expense is incurred; and (iv) the right to reimbursement or in kind benefits is not subject to liquidation or exchange for another benefit.

4. Termination

a. Rights and Duties. The Executive is an employee "at will." Accordingly, the Company or the Executive may terminate his employment, at any time with or without cause, for any lawful reason, or no reason. The Executive and the Company agree that, without modifying or altering the Executive's "at will" status, each will provide the other with at least thirty (30) days' prior written notice of termination of the Executive's employment with the Company. If the Executive gives notice of termination, except in the case of a termination by the Executive for "Good Reason" as set forth below, such notice will be deemed a voluntary resignation by the Executive and the Company, in its sole discretion, may elect to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, without changing the status of such termination as a voluntary resignation by the Executive. Should the Company in the event of a voluntary resignation decide to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, it shall nonetheless continue his compensation and benefits for the term of the notice period, except that no bonus shall be earned or awarded during and after the notice period.

b. Termination for "Good Reason." The Executive may terminate his employment at any time for "Good Reason." "Good Reason" shall comport with the requirements of Regulation §1.409A-l(n)(2)(ii) and shall mean:

i. A material diminution in the Executive's authority, duties, responsibilities or reporting responsibilities;

ii. A material diminution by the Company of the Executive's annual base compensation then in effect, except a material diminution generally affecting the members of the Company's management;

iii. Any action or inaction by the Company that constitutes a material breach by the Company of the terms of this Agreement; or

iv. A requirement that the Executive be based more than 50 miles from the offices at which he was principally employed immediately prior to the date of termination.

The parties acknowledge and agree that "Good Reason" shall not be deemed to have occurred unless: (1) the Executive provides the Company with written notice that he intends to terminate his employment hereunder for one of the Good Reason grounds set forth in Section 4.b. within sixty (60) days of the initial occurrence of such ground, with such notice containing a description of such ground, (2) if such Good Reason ground is capable of being cured, the Company has failed to cure such ground within a period of thirty (30) days from the date of such written notice, and (3) the Executive terminates his employment within ninety-one (91) days from the date that such Good Reason ground first occurs. For purposes of clarification, the above-listed conditions shall apply separately to each occurrence of a Good Reason ground, and failure to adhere to such conditions in the event of the occurrence of grounds that would otherwise have constituted Good Reason had the conditions herein been satisfied shall not disqualify the Executive from asserting and satisfying the conditions for Good Reason for any subsequent occurrence that may constitute Good Reason.

c. Termination by the Company for Cause. The Company may terminate the Executive's employment at any time for "Cause." "Cause" shall mean:

i. The Executive's commission of an act of fraud, dishonesty, breach of fiduciary duty or misappropriation which may or does adversely affect the Company;

ii. The Executive's conviction or plea of guilty or *nolo contendere* to or engaging in any felony or crime involving moral turpitude, fraud, misrepresentation or other crime and/or indictment for a crime that, in the reasonable opinion of the Company, affects the Executive's ability to perform the duties set forth in this Agreement and/or reflects negatively upon the Company;

iii. Unauthorized disclosure by the Executive of the Company's Proprietary Information, as defined in the Nondisclosure Agreement (as defined in Section 5 below), which results or could have been reasonably foreseen to result, in a material financial loss to the Company;

iv. The Executive's material breach of this Agreement or the Nondisclosure Agreement; provided, that if such breach is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such breach to cure; or

v. The Executive's failure (which shall not include any Disability as defined below) or refusal to perform the duties and responsibilities of his employment and/or to follow the policies and procedures of the Company, including without limitation the failure or refusal to carry out lawful instructions from the Board. If such failure or refusal is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such failure or refusal to cure.

d. Termination in the Event of Death or Disability. The Agreement shall terminate upon the Executive's death or Disability, and the Executive's employment with the Company shall thereupon terminate. For purposes of the Agreement, "Disability" is defined as any illness, injury, accident or condition of either a physical or psychological nature as a result of which the Executive is unable to perform the essential functions of his duties and responsibilities hereunder for 90 days during any period of 365 consecutive calendar days or for any consecutive 90-day period.

e. Effect of Termination.

i. If the Executive is terminated by the Company for Cause, or by the Executive voluntarily other than for Good Reason, then the Executive will only be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued but unused prior to termination of employment.

ii. If the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) Continuation of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination for a twelve (12) month period, payable in accordance with the Company's regular payroll practices, less applicable withholdings, commencing at the conclusion of the Review Period (as described below), *provided* that the first installment of such payments shall include all amounts which would have been paid during the period between the Executive's date of termination and the date of such first installment;

b) Payment of a pro-rata portion of the actual amount of the Executive's Annual Bonus based on actual performance determined under the terms of the Company's annual bonus program as then in effect, with such pro-rata portion calculated by multiplying the actual amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made after the determination of the bonus funding level (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs); and

c) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) twelve (12) months or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for

premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA.

iii. If the Agreement is terminated because of the Executive's death, the Company shall pay to the estate of the Executive the salary and benefits which would otherwise have been payable to the Executive up to the date of termination of his employment because of death.

iv. In the event of a Change of Control (as defined below) occurs and, if within one (1) year thereafter, the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) A lump sum payment equal to the sum of (i) one (1) year of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination, less applicable withholdings, plus (ii) the Executive's target annual bonus for the year in which the termination occurs, less applicable withholdings, payable at the conclusion of the Review Period (as described below);

b) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) one (1) year or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA; and

c) Payment of a pro-rata portion of the target amount of the Executive's annual bonus, with such pro-rata portion calculated by multiplying the target amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made at the conclusion of the Review Period (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs).

v. In addition, in the event of a Change of Control, notwithstanding anything to the contrary in any applicable option agreement or stock-based award agreement, all time-based stock options and other time-based stock-based awards held by the Executive, to the extent unvested as of immediately prior to the Change of Control shall immediately accelerate and become fully exercisable or nonforfeitable immediately prior to the consummation of the Change of Control.

For purposes of this Agreement, "Change of Control" means (A) the occurrence of a merger or consolidation of the Company whether or not approved by the Board, other than (i) a merger or consolidation which would result in the voting securities of the Company outstanding immediately prior thereto continuing to represent (either by remaining outstanding or by being converted into voting securities of the surviving entity or the parent of such corporation) at least 50% of the total voting power represented by the voting securities of the Company or such surviving entity or parent of such corporation outstanding immediately after such merger or consolidation, or (ii) a merger or consolidation which is in effect a financing transaction for the Company, including, but not limited to, a reverse merger of the Company into a publicly traded "shell" company, or (B) the stockholders of the Company approve an agreement for the sale or disposition by the Company of all or substantially all of the Company's assets, provided that, in any case, "Change of Control" shall be in accordance with Regulation §1.409A-3(i)(5).

vi. Payment of the severance pay and benefits described in Section 4.e.ii. or 4.e.iv., as applicable, is expressly conditioned on the Executive's execution without revocation of the separation agreement and general release described therein, within the time period prescribed in the separation agreement and general release (which release shall include, at the Company's option, a non-competition obligation during any salary

continuation period and (at the Company's option) a revocation period of seven (7) business days), and will commence immediately following a sixty (60) day period following the effective date of the Executive's separation from service from the Company (the "Review Period") (with the exception of the pro rata annual bonus payment described in Section 4.e.ii.b., which shall be payable after the bonus funding level is determined but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs). The separation agreement and general release will be provided to the Executive on or before the fifth (5th) day following such separation from service. If the Executive fails or refuses to return such agreement within the Review Period, the applicable severance payments and benefits will be forfeited. If the Executive is eligible for the severance pay and benefits described in Section 4.e.ii., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.iv. Similarly, if the Executive is eligible for the severance pay and benefits described in Section 4.e.iv., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.ii.

5. Nondisclosure, Non-Solicitation and Assignment Agreement. As a condition of the Executive's employment by the Company and the payment of compensation and receipt of benefits referred to above, the Executive agrees to continue to be bound by the terms of the standard **Nondisclosure, Non-Solicitation and Assignment Agreement**, entered into by the Executive as of January 14, 2016 (the "Nondisclosure Agreement"). The Executive acknowledges that the Company would not offer him employment or provide compensation and/or benefits set forth above if he was not willing to be bound by the terms of such Nondisclosure Agreement.

6. Notice.

a. To the Company. The Executive will send all communications to the Company in writing, addressed as follows (or in any other manner the Company notifies him to use):

Douglas M. Fambrough III, Ph.D. President and CEO
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

With a copy to:

General Counsel
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

b. To the Executive. All communications from the Company to the Executive relating to this Agreement shall be sent to the Executive in writing, at the most recent address on file with the Company.

With a copy to:

John B. Green
91 Elliot Drive
Lowell, MA 01852

c. Time Notice Deemed Given. Notice shall be deemed to have been given when delivered or, if earlier (1) three business days after mailing by United States certified or registered mail, return receipt requested, postage prepaid, or
(2) sent by overnight mail or delivery with confirmation of delivery, in either case, addressed as required in this section.

7. Amendment. No provisions of this Agreement may be modified, waived, or discharged except by a written document signed by a Company officer duly authorized by the Board and the Executive. A waiver of any conditions or provisions of this Agreement in a given instance shall not be deemed a waiver of such conditions or provisions at any other time in the future.

8. Choice of Law; Forum Selection. The validity, interpretation, construction, and performance of this Agreement shall be governed by the laws of the Commonwealth of Massachusetts without regard to its conflicts of laws principles. Any claims or legal actions by one party against the other regarding this Agreement shall be commenced and maintained exclusively in any state or federal court located in the Commonwealth of Massachusetts, and the parties hereby submit to the jurisdiction and venue of any such court.

9. Successors. This Agreement shall be binding upon, and shall inure to the benefit of, the Executive and his estate, but the Executive may not assign or pledge this Agreement or any rights arising under it. Without the Executive's consent, the Company may assign this Agreement to any affiliate or to a successor to substantially all the business and assets of the Company.

10. Taxes; Code Sections 409A and 280G.

a. The Company shall withhold taxes from payments it makes pursuant to this Agreement as it reasonably determines to be required by applicable law.

b. If the benefits set forth in Section 4.e. of this Agreement constitute "non-qualified deferred compensation" subject to Section 409A, then the following conditions apply to the payment of such benefits:

i. Any termination of the Executive's employment triggering payment of benefits under Section 4.e. must constitute a "separation from service" under Section 409A(a)(2)(A)(i) of the Code, and Treas. Reg. §1.409A-1(h) before distribution of such benefits can commence. To the extent that the termination of the Executive's employment does not constitute a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h) (as the result of further services that are reasonably anticipated to be provided by the Executive to the Company at the time the Executive's employment terminates), any benefits payable under Section 4.e. that constitute non-qualified deferred compensation under Section 409A shall be delayed until after the date of a subsequent event constituting a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h). For purposes of clarification, this Section shall not cause any forfeiture of benefits on the Executive's part, but shall only act as a delay until such time as a "separation from service" occurs.

ii. If the Executive is a "specified employee" (as that term is used in Section 409A and regulations and other guidance issued thereunder) on the date his separation from service becomes effective, any benefits payable under Section 4.e. that constitute non-qualified deferred compensation subject to Section 409A shall be delayed until the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the date of the Executive's death, but only to the extent necessary to avoid the adverse tax consequences and penalties under Section 409A. On the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the Executive's death, the Company shall pay the Executive in a lump sum the aggregate value of the non-qualified deferred compensation that the Company otherwise would have paid the Executive prior to that date under Section 4.e.

iii. If any amount to be paid to the Executive pursuant to this Agreement is "deferred compensation" subject to Section 409A, then each such payment which is conditioned upon Executive's execution of a release and which is to be paid or provided during a designated period that begins in one taxable year and ends in a second taxable year, shall be paid or provided in the later of the two taxable years.

iv. It is intended that each installment of the payments and benefits provided under Section 4.e. shall be treated as a separate "payment" for purposes of Section 409A.

v. Neither the Company nor the Executive shall have the right to accelerate or defer the delivery of any such payments or benefits except to the extent specifically permitted or required by Section 409A.

c. Notwithstanding any other provision of this Agreement to the contrary, in the event of any ambiguity in the terms of this Agreement, such term(s) shall be interpreted and at all times administered in a manner that avoids the inclusion of compensation in income under Section 409A, or the payment of increased taxes, excise taxes or other penalties under Section 409A.

d. The parties intend this Agreement to be in compliance with Section 409A. Executive acknowledges and agrees that Company does not guarantee the tax treatment or tax consequences associated with any payment or benefit arising under this Agreement, including but not limited to consequences related to Section 409A.

e. If any payment or benefit the Executive would receive under this Agreement, when combined with any other payment or benefit Executive receives pursuant to a Change of Control (whether under this Agreement or otherwise) (such payment or benefit, for purposes of this section, a "Payment") would: (i) constitute a "parachute payment" within the meaning of Section 280G of the Code; and (ii) but for this sentence, be subject to the excise tax imposed by Section 4999 of the Code (the "Excise Tax"), then such Payment shall be either: (A) the full amount of such Payment; or (B) such lesser amount as would result in no portion of the Payment being subject to the Excise Tax, whichever of the foregoing amounts, taking into account the applicable federal, state and local employments taxes, income taxes, and the Excise Tax, results in Executive's receipt, on an after-tax basis, of the greater amount of the Payment notwithstanding that all or some portion of the Payment may be subject to the Excise Tax. The Payments will be reduced in the following order: (A) reduction of any cash severance payments otherwise payable to the Executive that are exempt from Section 409A of the Code; (B) reduction of any other cash payments or benefits otherwise payable to the Executive that are exempt from Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code; (C) reduction of any other payments or benefits otherwise payable to the Executive on a pro-rata basis or such other manner that complies with Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting and payments with respect to any equity awards that are exempt from Section 409A of the Code; and (D) reduction of any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code, in each case beginning with payments that would otherwise be made last in time.

11. Validity. The invalidity or unenforceability of any provision of this Agreement shall not affect the validity or enforceability of any other provision of this Agreement, which shall remain in full force and effect.

12. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original but all of which together shall constitute the same instrument.

13. Entire Agreement; Prior Agreements. This Agreement constitutes the entire agreement among the parties with respect to the subject matter hereof and, unless otherwise provided herein, supersedes all prior agreements, negotiations or understandings, written or oral, in respect thereof.

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DICERNA PHARMACEUTICALS, INC.

Date: 2/21/2020

/s/ Douglas M. Fambrough III, PhD.
By: Douglas Fambrough III, Ph.D.
Its: President and CEO

Date: 2/25/2020

/s/ John Green

John B. Green
Chief Financial Officer

Exhibit 10.30

EMPLOYMENT AGREEMENT (Revised)

EMPLOYMENT AGREEMENT ("Agreement") made this February 21, 2020 (the "Effective Date") between Dicerna Pharmaceuticals, Inc., a Delaware corporation ("Company"), on the one hand and James B. Weissman (the "Executive") on the other hand.

WHEREAS, the Company desires to employ the Executive and the Executive desires to be employed by the Company, on terms set forth herein;

NOW, THEREFORE, in consideration of the mutual agreements set forth herein, the parties agree as follows:

1. Term of Employment. The Executive's employment under this Agreement shall commence on the Effective Date and shall end on such date as the Executive's employment terminates in accordance with Section 4 of this Agreement. Subject to the balance of this Agreement, the Executive shall be an at-will employee of the Company whose employment may be terminated (by the Company or by the Executive) at any time, for any or no reason, in which case the Executive will be entitled to the separation benefits set forth in Section 4, below.

2. Duties. During his employment with the Company, the Executive shall have the title of Executive Vice President and Chief Operating Officer. The Executive shall devote his full business time and effort to the performance of his duties for the Company, which he shall perform faithfully and to the best of his ability. The Executive shall have all of the customary powers and duties associated with his position and shall be subject to the Company's policies, procedures, and approval practices, as generally in effect from time to time for all senior executives of the Company and the direction and oversight of the Board. The Executive will report directly to the Chief Executive Officer of the Company.

3. Compensation and Related Matters.

a. Base Salary. The Company shall pay the Executive base salary at a rate of $17,724 paid twice monthly (which annualizes to $425,384), less withholdings and deductions required and/or permitted by law. The Executive's base salary shall be paid in conformity with the Company's payroll practices generally applicable to the Company's senior executives.

b. Signing and Annual Bonus. The Company paid the Executive a one-time signing bonus (the "Signing Bonus") of $60,000 (less applicable withholding taxes and deductions) payable within 30 days of the Executive's start date at the Company. The Signing Bonus is subject to the following repayment obligations: as a condition of the Executive's employment with the Company and for receiving the Signing Bonus, the Executive agrees that if, at any time during the twelve months following the Executive's first date of employment with the Company, the Executive (a) resigns his employment with the Company, he shall repay the Signing Bonus, on a pro-rata basis based on length of service; or
(b) the Company terminates the Executive's employment for Cause, he shall repay the Signing Bonus in-full, and in all cases specifically authorize the Company to deduct all of the Signing Bonus required to be repaid from his last paycheck and to the extent that there is a balance still owed by the Executive, he will provide payment of such balance within thirty days (30) of his last date of employment. The Executive shall be eligible to be considered for an Annual Bonus upon achieving of certain pre-determined performance targets consistent with any Incentive Compensation Plan established by the Compensation Committee (the "Committee"). The Annual Bonus shall be based, in part, on the Executive's performance. The grant of such a bonus shall be in the sole discretion of the Committee. The maximum bonus amount for which the Executive will be eligible is forty-five percent (45%)of base salary earned for the calendar year, provided that, the Annual Bonus for the first year of employment shall be prorated based on the date of hire. The Annual Bonus will be earned only after it has been granted by the Committee. The Annual Bonus shall be paid to the Executive following the close of the fiscal year to which it relates, in no event later than March 15th of the calendar year immediately following the calendar year in which it was earned. The Executive must be actively employed by the Company at the time the Committee considers granting of bonuses to be eligible to receive such bonus.

c. Equity Compensation. Subject to approval of the Board or an appropriate committee thereof, Executive shall be eligible for equity compensation awards, in such amounts and subject to such terms as shall be commensurate with awards granted to other senior executives of the Company.

d. Benefits. During his employment with the Company, the Executive shall be entitled to participate in all employee benefit plans and programs, including paid sick leave and holidays, life insurance, disability, medical, dental, and retirement savings plans, to the same extent generally available to senior executives of the Company, in accordance with the terms of those plans and programs. The Executive shall be permitted up to four weeks of paid vacation per year, which will accrue on a monthly basis. The Executive will not be allowed to accumulate more than three weeks of unused vacation days at any given time. The Executive may carry over a maximum of ten unused vacation days from one calendar year to the next.

e. Expenses. The Company agrees to reimburse the Executive for reasonable out-of-pocket expenses incurred in connection with Company business and within standards to be established by the Board from time to time, including, without limitation, travel and accommodations for authorized business trips, provided vouchers therefor, or other supporting information as the Company may reasonably require, are presented to the Company. All reimbursements provided under this Agreement shall be made or provided in accordance with the requirements of Section 409A of the Internal Revenue Code of 1986, as amended (the "Code") and the rules and regulations thereunder ("Section 409A") including, where applicable, the requirement that (i) any reimbursement is for expenses incurred during the Executive's lifetime (or during a shorter period of time specified in this Agreement); (ii) the amount of expenses eligible for reimbursement during a calendar year may not affect the expenses eligible for reimbursement in any other calendar year; (iii) the reimbursement of an eligible expense shall be made no later than the last day of the calendar year following the year in which the expense is incurred; and (iv) the right to reimbursement or in kind benefits is not subject to liquidation or exchange for another benefit.

4. Termination

a. Rights and Duties. The Executive is an employee "at will." Accordingly, the Company or the Executive may terminate his employment, at any time with or without cause, for any lawful reason, or no reason. The Executive and the Company agree that, without modifying or altering the Executive's "at will" status, each will provide the other with at least thirty (30) days' prior written notice of termination of the Executive's employment with the Company. If the Executive gives notice of termination, except in the case of a termination by the Executive for "Good Reason" as set forth below, such notice will be deemed a voluntary resignation by the Executive and the Company, in its sole discretion, may elect to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, without changing the status of such termination as a voluntary resignation by the Executive. Should the Company in the event of a voluntary resignation decide to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, it shall nonetheless continue his compensation and benefits for the term of the notice period, except that no bonus shall be earned or awarded during and after the notice period.

b. Termination for "Good Reason." The Executive may terminate his employment at any time for "Good Reason." "Good Reason" shall comport with the requirements of Regulation §1.409A-l(n)(2)(ii) and shall mean:

i. A material diminution in the Executive's authority, duties, responsibilities or reporting responsibilities;

ii. A material diminution by the Company of the Executive's annual base compensation then in effect, except a material diminution generally affecting the members of the Company's management;

iii. Any action or inaction by the Company that constitutes a material breach by the Company of the terms of this Agreement; or

iv. A requirement that the Executive be based more than 50 miles from the offices at which he was principally employed immediately prior to the date of termination.

The parties acknowledge and agree that "Good Reason" shall not be deemed to have occurred unless: (1) the Executive provides the Company with written notice that he intends to terminate his employment hereunder for one of the Good Reason grounds set forth in Section 4.b. within sixty (60) days of the initial occurrence of such ground, with such notice containing a description of such ground, (2) if such Good Reason ground is capable of being cured, the Company has failed to cure such ground within a period of thirty (30) days from the date of such written notice, and (3) the Executive terminates his employment within ninety-one (91) days from the date that such Good Reason ground first occurs. For purposes of clarification, the above-listed conditions shall apply separately to each occurrence of a Good Reason ground, and failure to adhere to such conditions in the event of the occurrence of grounds that would otherwise

have constituted Good Reason had the conditions herein been satisfied shall not disqualify the Executive from asserting and satisfying the conditions for Good Reason for any subsequent occurrence that may constitute Good Reason.

c. Termination by the Company for Cause. The Company may terminate the Executive's employment at any time for "Cause." "Cause" shall mean:

i. The Executive's commission of an act of fraud, dishonesty, breach of fiduciary duty or misappropriation which may or does adversely affect the Company;

ii. The Executive's conviction or plea of guilty or *nolo contendere* to or engaging in any felony or crime involving moral turpitude, fraud, misrepresentation or other crime and/or indictment for a crime that, in the reasonable opinion of the Company, affects the Executive's ability to perform the duties set forth in this Agreement and/or reflects negatively upon the Company;

iii. Unauthorized disclosure by the Executive of the Company's Proprietary Information, as defined in the Nondisclosure Agreement (as defined in Section 5 below), which results or could have been reasonably foreseen to result, in a material financial loss to the Company;

iv. The Executive's material breach of this Agreement or the Nondisclosure Agreement; provided, that if such breach is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such breach to cure; or

v. The Executive's failure (which shall not include any Disability as defined below) or refusal to perform the duties and responsibilities of his employment and/or to follow the policies and procedures of the Company, including without limitation the failure or refusal to carry out lawful instructions from the Board. If such failure or refusal is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such failure or refusal to cure.

d. Termination in the Event of Death or Disability. The Agreement shall terminate upon the Executive's death or Disability, and the Executive's employment with the Company shall thereupon terminate. For purposes of the Agreement, "Disability" is defined as any illness, injury, accident or condition of either a physical or psychological nature as a result of which the Executive is unable to perform the essential functions of his duties and responsibilities hereunder for 90 days during any period of 365 consecutive calendar days or for any consecutive 90-day period.

e. Effect of Termination.

i. If the Executive is terminated by the Company for Cause, or by the Executive voluntarily other than for Good Reason, then the Executive will only be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued but unused prior to termination of employment.

ii. If the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) Continuation of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination for a twelve (12) month period, payable in accordance with the Company's regular payroll practices, less applicable withholdings, commencing at the conclusion of the Review Period (as described below), *provided* that the first installment of such payments shall include all amounts which would have been paid during the period between the Executive's date of termination and the date of such first installment;

b) Payment of a pro-rata portion of the actual amount of the Executive's Annual Bonus based on actual performance determined under the terms of the Company's annual bonus program as then in effect, with such pro-rata portion calculated by multiplying the actual amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three

hundred sixty five (365), with such payment to be made after the determination of the bonus funding level (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs); and

c) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) twelve (12) months or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA.

iii. If the Agreement is terminated because of the Executive's death, the Company shall pay to the estate of the Executive the salary and benefits which would otherwise have been payable to the Executive up to the date of termination of his employment because of death.

iv. In the event of a Change of Control (as defined below) occurs and, if within one (1) year thereafter, the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) A lump sum payment equal to the sum of (i) one (1) year of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination, less applicable withholdings, plus (ii) the Executive's target annual bonus for the year in which the termination occurs, less applicable withholdings, payable at the conclusion of the Review Period (as described below);

b) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) one (1) year or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA; and

c) Payment of a pro-rata portion of the target amount of the Executive's annual bonus, with such pro-rata portion calculated by multiplying the target amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made at the conclusion of the Review Period (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs).

v. In addition, in the event of a Change of Control, notwithstanding anything to the contrary in any applicable option agreement or stock-based award agreement, all time-based stock options and other time-based stock-based awards held by the Executive, to the extent unvested as of immediately prior to the Change of Control shall immediately accelerate and become fully exercisable or nonforfeitable immediately prior to the consummation of the Change of Control.

For purposes of this Agreement, "Change of Control" means (A) the occurrence of a merger or consolidation of the Company whether or not approved by the Board, other than (i) a merger or consolidation which would result in the voting securities of the Company outstanding immediately prior thereto continuing to represent (either by remaining outstanding or by being converted into voting securities of the surviving entity or the parent of such corporation) at least 50% of the total voting power represented by the voting securities of the Company or such surviving entity or parent of such corporation outstanding immediately after such merger or consolidation, or (ii) a merger or consolidation which is in

effect a financing transaction for the Company, including, but not limited to, a reverse merger of the Company into a publicly traded "shell" company, or (B) the stockholders of the Company approve an agreement for the sale or disposition by the Company of all or substantially all of the Company's assets, provided that, in any case, "Change of Control" shall be in accordance with Regulation §1.409A-3(i)(5).

vi. Payment of the severance pay and benefits described in Section 4.e.ii. or 4.e.iv., as applicable, is expressly conditioned on the Executive's execution without revocation of the separation agreement and general release described therein, within the time period prescribed in the separation agreement and general release (which release shall include, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days), and will commence immediately following a sixty (60) day period following the effective date of the Executive's separation from service from the Company (the "Review Period") (with the exception of the pro rata annual bonus payment described in Section 4.e.ii.b., which shall be payable after the bonus funding level is determined but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs). The separation agreement and general release will be provided to the Executive on or before the fifth (5th) day following such separation from service. If the Executive fails or refuses to return such agreement within the Review Period, the applicable severance payments and benefits will be forfeited. If the Executive is eligible for the severance pay and benefits described in Section 4.e.ii., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.iv. Similarly, if the Executive is eligible for the severance pay and benefits described in Section 4.e.iv., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.ii.

5. Nondisclosure, Non-Solicitation and Assignment Agreement. As a condition of the Executive's employment by the Company and the payment of compensation and receipt of benefits referred to above, the Executive agrees to continue to be bound by the terms of the standard **Nondisclosure, Non-Solicitation and Assignment Agreement**, entered into by the Executive as of 12/5/2011 (the "Nondisclosure Agreement"). The Executive acknowledges that the Company would not offer him employment or provide compensation and/or benefits set forth above if he was not willing to be bound by the terms of such Nondisclosure Agreement.

6. Notice.

a. To the Company. The Executive will send all communications to the Company in writing, addressed as follows (or in any other manner the Company notifies him to use):

Douglas M. Fambrough III, Ph.D. President and CEO
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

With a copy to:

General Counsel
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

b. To the Executive. All communications from the Company to the Executive relating to this Agreement shall be sent to the Executive in writing, at the most recent address on file with the Company.

With a copy to:

James B. Weissman
9 Evans Ave
Bedford, MA 01730

c. Time Notice Deemed Given. Notice shall be deemed to have been given when delivered or, if earlier (1) three business days after mailing by United States certified or registered mail, return receipt requested, postage prepaid, or
(2) sent by overnight mail or delivery with confirmation of delivery, in either case, addressed as required in this section.

7. Amendment. No provisions of this Agreement may be modified, waived, or discharged except by a written document signed by a Company officer duly authorized by the Board and the Executive. A waiver of any conditions or provisions of this Agreement in a given instance shall not be deemed a waiver of such conditions or provisions at any other time in the future.

8. Choice of Law; Forum Selection. The validity, interpretation, construction, and performance of this Agreement shall be governed by the laws of the Commonwealth of Massachusetts without regard to its conflicts of laws principles. Any claims or legal actions by one party against the other regarding this Agreement shall be commenced and maintained exclusively in any state or federal court located in the Commonwealth of Massachusetts, and the parties hereby submit to the jurisdiction and venue of any such court.

9. Successors. This Agreement shall be binding upon, and shall inure to the benefit of, the Executive and his estate, but the Executive may not assign or pledge this Agreement or any rights arising under it. Without the Executive's consent, the Company may assign this Agreement to any affiliate or to a successor to substantially all the business and assets of the Company.

10. Taxes; Code Sections 409A and 280G.

a. The Company shall withhold taxes from payments it makes pursuant to this Agreement as it reasonably determines to be required by applicable law.

b. If the benefits set forth in Section 4.e. of this Agreement constitute "non-qualified deferred compensation" subject to Section 409A, then the following conditions apply to the payment of such benefits:

i. Any termination of the Executive's employment triggering payment of benefits under Section 4.e. must constitute a "separation from service" under Section 409A(a)(2)(A)(i) of the Code, and Treas. Reg.
§1.409A-1(h) before distribution of such benefits can commence. To the extent that the termination of the Executive's employment does not constitute a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h) (as the result of further services that are reasonably anticipated to be provided by the Executive to the Company at the time the Executive's employment terminates), any benefits payable under Section 4.e. that constitute non-qualified deferred compensation under Section 409A shall be delayed until after the date of a subsequent event constituting a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h). For purposes of clarification, this Section shall not cause any forfeiture of benefits on the Executive's part, but shall only act as a delay until such time as a "separation from service" occurs.

ii. If the Executive is a "specified employee" (as that term is used in Section 409A and regulations and other guidance issued thereunder) on the date his separation from service becomes effective, any benefits payable under Section 4.e. that constitute non-qualified deferred compensation subject to Section 409A shall be delayed until the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the date of the Executive's death, but only to the extent necessary to avoid the adverse tax consequences and penalties under Section 409A. On the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the Executive's death, the Company shall pay the Executive in a lump sum the aggregate value of the non-qualified deferred compensation that the Company otherwise would have paid the Executive prior to that date under Section 4.e.

iii. If any amount to be paid to the Executive pursuant to this Agreement is "deferred compensation" subject to Section 409A, then each such payment which is conditioned upon Executive's execution of a release and which is to be paid or provided during a designated period that begins in one taxable year and ends in a second taxable year, shall be paid or provided in the later of the two taxable years.

iv. It is intended that each installment of the payments and benefits provided under Section 4.e. shall be treated as a separate "payment" for purposes of Section 409A.

v. Neither the Company nor the Executive shall have the right to accelerate or defer the delivery of any such payments or benefits except to the extent specifically permitted or required by Section 409A.

c. Notwithstanding any other provision of this Agreement to the contrary, in the event of any ambiguity in the terms of this Agreement, such term(s) shall be interpreted and at all times administered in a manner that avoids the inclusion of compensation in income under Section 409A, or the payment of increased taxes, excise taxes or other penalties under Section 409A.

d. The parties intend this Agreement to be in compliance with Section 409A. Executive acknowledges and agrees that Company does not guarantee the tax treatment or tax consequences associated with any payment or benefit arising under this Agreement, including but not limited to consequences related to Section 409A.

e. If any payment or benefit the Executive would receive under this Agreement, when combined with any other payment or benefit Executive receives pursuant to a Change of Control (whether under this Agreement or otherwise) (such payment or benefit, for purposes of this section, a "Payment") would: (i) constitute a "parachute payment" within the meaning of Section 280G of the Code; and (ii) but for this sentence, be subject to the excise tax imposed by Section 4999 of the Code (the "Excise Tax"), then such Payment shall be either: (A) the full amount of such Payment; or (B) such lesser amount as would result in no portion of the Payment being subject to the Excise Tax, whichever of the foregoing amounts, taking into account the applicable federal, state and local employments taxes, income taxes, and the Excise Tax, results in Executive's receipt, on an after-tax basis, of the greater amount of the Payment notwithstanding that all or some portion of the Payment may be subject to the Excise Tax. The Payments will be reduced in the following order: (A) reduction of any cash severance payments otherwise payable to the Executive that are exempt from Section 409A of the Code; (B) reduction of any other cash payments or benefits otherwise payable to the Executive that are exempt from Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code; (C) reduction of any other payments or benefits otherwise payable to the Executive on a pro-rata basis or such other manner that complies with Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting and payments with respect to any equity awards that are exempt from Section 409A of the Code; and (D) reduction of any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code, in each case beginning with payments that would otherwise be made last in time.

11. Validity. The invalidity or unenforceability of any provision of this Agreement shall not affect the validity or enforceability of any other provision of this Agreement, which shall remain in full force and effect.

12. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original but all of which together shall constitute the same instrument.

13. Entire Agreement; Prior Agreements. This Agreement constitutes the entire agreement among the parties with respect to the subject matter hereof and, unless otherwise provided herein, supersedes all prior agreements, negotiations or understandings, written or oral, in respect thereof.

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DICERNA PHARMACEUTICALS, INC.

Date: 2/21/2020 /s/ Douglas M. Fambrough

By: Douglas M. Fambrough III, Ph.D.
Its: President and CEO

Date: 2/24/2020 /s/ James B. Weissman

James B. Weissman
EVP and Chief Operating Officer

Exhibit 10.31

EMPLOYMENT AGREEMENT (Revised)

EMPLOYMENT AGREEMENT ("Agreement") made this February 21, 2020 (the "Effective Date") between Dicerna Pharmaceuticals, Inc., a Delaware corporation ("Company"), on the one hand and Bob D. Brown (the "Executive") on the other hand.

WHEREAS, the Company desires to employ the Executive and the Executive desires to be employed by the Company, on terms set forth herein;

NOW, THEREFORE, in consideration of the mutual agreements set forth herein, the parties agree as follows:

1. Term of Employment. The Executive's employment under this Agreement shall commence on the Effective Date and shall end on such date as the Executive's employment terminates in accordance with Section 4 of this Agreement. Subject to the balance of this Agreement, the Executive shall be an at-will employee of the Company whose employment may be terminated (by the Company or by the Executive) at any time, for any or no reason, in which case the Executive will be entitled to the separation benefits set forth in Section 4, below.

2. Duties. During his employment with the Company, the Executive shall have the title of Executive Vice President, Research & Development and Chief Scientific Officer. The Executive shall devote his full business time and effort to the performance of his duties for the Company, which he shall perform faithfully and to the best of his ability. The Executive shall have all of the customary powers and duties associated with his position and shall be subject to the Company's policies, procedures, and approval practices, as generally in effect from time to time for all senior executives of the Company and the direction and oversight of the Board. The Executive will report directly to the Chief Executive Officer & President of the Company.

3. Compensation and Related Matters.

a. Base Salary. The Company shall pay the Executive base salary at a rate of $20,002 paid twice monthly (which annualizes to $480,041), less withholdings and deductions required and/or permitted by law. The Executive's base salary shall be paid in conformity with the Company's payroll practices generally applicable to the Company's senior executives.

b. Annual Bonus.

The Executive shall be eligible to be considered for an Annual Bonus upon achieving of certain pre-determined performance targets consistent with any Incentive Compensation Plan established by the Compensation Committee (the "Committee"). The Annual Bonus shall be based, in part, on the Executive's performance. The grant of such a bonus shall be in the sole discretion of the Committee. The maximum bonus amount for which the Executive will be eligible is forty-five percent (45%)of base salary earned for the calendar year, provided that, the Annual Bonus for the first year of employment shall be prorated based on the date of hire. The Annual Bonus will be earned only after it has been granted by the Committee. The Annual Bonus shall be paid to the Executive following the close of the fiscal year to which it relates, in no event later than March 15th of the calendar year immediately following the calendar year in which it was earned. The Executive must be actively employed by the Company at the time the Committee considers granting of bonuses to be eligible to receive such bonus.

c. Equity Compensation. Subject to approval of the Board or an appropriate committee thereof, Executive shall be eligible for equity compensation awards, in such amounts and subject to such terms as shall be commensurate with awards granted to other senior executives of the Company.

d. Benefits. During his employment with the Company, the Executive shall be entitled to participate in all employee benefit plans and programs, including paid sick leave and holidays, life insurance, disability, medical, dental, and retirement savings plans, to the same extent generally available to senior executives of the Company, in accordance with the terms of those plans and programs. The Executive shall be permitted up to four weeks of paid vacation per year, which will accrue on a monthly basis. The Executive will not be allowed to accumulate more than three weeks of unused vacation days at any given time. The Executive may carry over a maximum of ten unused vacation days from one calendar year to the next.

e. Expenses. The Company agrees to reimburse the Executive for reasonable out-of-pocket expenses incurred in connection with Company business and within standards to be established by the Board from time to time, including, without limitation, travel and accommodations for authorized business trips, provided vouchers therefor, or other supporting information as the Company may reasonably require, are presented to the Company. All reimbursements provided under this Agreement shall be made or provided in accordance with the requirements of Section 409A of the Internal Revenue Code of 1986, as amended (the "Code") and the rules and regulations thereunder ("Section 409A") including, where applicable, the requirement that (i) any reimbursement is for expenses incurred during the Executive's lifetime (or during a shorter period of time specified in this Agreement); (ii) the amount of expenses eligible for reimbursement during a calendar year may not affect the expenses eligible for reimbursement in any other calendar year; (iii) the reimbursement of an eligible expense shall be made no later than the last day of the calendar year following the year in which the expense is incurred; and (iv) the right to reimbursement or in kind benefits is not subject to liquidation or exchange for another benefit.

4. Termination

a. Rights and Duties. The Executive is an employee "at will." Accordingly, the Company or the Executive may terminate his employment, at any time with or without cause, for any lawful reason, or no reason. The Executive and the Company agree that, without modifying or altering the Executive's "at will" status, each will provide the other with at least thirty (30) days' prior written notice of termination of the Executive's employment with the Company. If the Executive gives notice of termination, except in the case of a termination by the Executive for "Good Reason" as set forth below, such notice will be deemed a voluntary resignation by the Executive and the Company, in its sole discretion, may elect to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, without changing the status of such termination as a voluntary resignation by the Executive. Should the Company in the event of a voluntary resignation decide to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, it shall nonetheless continue his compensation and benefits for the term of the notice period, except that no bonus shall be earned or awarded during and after the notice period.

b. Termination for "Good Reason." The Executive may terminate his employment at any time for "Good Reason." "Good Reason" shall comport with the requirements of Regulation §1.409A-l(n)(2)(ii) and shall mean:

i. A material diminution in the Executive's authority, duties, responsibilities or reporting responsibilities;

ii. A material diminution by the Company of the Executive's annual base compensation then in effect, except a material diminution generally affecting the members of the Company's management;

iii. Any action or inaction by the Company that constitutes a material breach by the Company of the terms of this Agreement; or

iv. A requirement that the Executive be based more than 50 miles from the offices at which he was principally employed immediately prior to the date of termination.

The parties acknowledge and agree that "Good Reason" shall not be deemed to have occurred unless: (1) the Executive provides the Company with written notice that he intends to terminate his employment hereunder for one of the Good Reason grounds set forth in Section 4.b. within sixty (60) days of the initial occurrence of such ground, with such notice containing a description of such ground, (2) if such Good Reason ground is capable of being cured, the Company has failed to cure such ground within a period of thirty (30) days from the date of such written notice, and (3) the Executive terminates his employment within ninety-one (91) days from the date that such Good Reason ground first occurs. For purposes of clarification, the above-listed conditions shall apply separately to each occurrence of a Good Reason ground, and failure to adhere to such conditions in the event of the occurrence of grounds that would otherwise have constituted Good Reason had the conditions herein been satisfied shall not disqualify the Executive from asserting and satisfying the conditions for Good Reason for any subsequent occurrence that may constitute Good Reason.

c. Termination by the Company for Cause. The Company may terminate the Executive's employment at any time for "Cause." "Cause" shall mean:

i. The Executive's commission of an act of fraud, dishonesty, breach of fiduciary duty or misappropriation which may or does adversely affect the Company;

ii. The Executive's conviction or plea of guilty or *nolo contendere* to or engaging in any felony or crime involving moral turpitude, fraud, misrepresentation or other crime and/or indictment for a crime that, in the reasonable opinion of the Company, affects the Executive's ability to perform the duties set forth in this Agreement and/or reflects negatively upon the Company;

iii. Unauthorized disclosure by the Executive of the Company's Proprietary Information, as defined in the Nondisclosure Agreement (as defined in Section 5 below), which results or could have been reasonably foreseen to result, in a material financial loss to the Company;

iv. The Executive's material breach of this Agreement or the Nondisclosure Agreement; provided, that if such breach is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such breach to cure; or

v. The Executive's failure (which shall not include any Disability as defined below) or refusal to perform the duties and responsibilities of his employment and/or to follow the policies and procedures of the Company, including without limitation the failure or refusal to carry out lawful instructions from the Board. If such failure or refusal is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such failure or refusal to cure.

d. Termination in the Event of Death or Disability. The Agreement shall terminate upon the Executive's death or Disability, and the Executive's employment with the Company shall thereupon terminate. For purposes of the Agreement, "Disability" is defined as any illness, injury, accident or condition of either a physical or psychological nature as a result of which the Executive is unable to perform the essential functions of his duties and responsibilities hereunder for 90 days during any period of 365 consecutive calendar days or for any consecutive 90-day period.

e. Effect of Termination.

i. If the Executive is terminated by the Company for Cause, or by the Executive voluntarily other than for Good Reason, then the Executive will only be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued but unused prior to termination of employment.

ii. If the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) Continuation of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination for a twelve (12) month period, payable in accordance with the Company's regular payroll practices, less applicable withholdings, commencing at the conclusion of the Review Period (as described below), *provided* that the first installment of such payments shall include all amounts which would have been paid during the period between the Executive's date of termination and the date of such first installment;

b) Payment of a pro-rata portion of the actual amount of the Executive's Annual Bonus based on actual performance determined under the terms of the Company's annual bonus program as then in effect, with such pro-rata portion calculated by multiplying the actual amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made after the determination of the bonus funding level (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs); and

c) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) twelve (12) months or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for

premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA.

iii. If the Agreement is terminated because of the Executive's death, the Company shall pay to the estate of the Executive the salary and benefits which would otherwise have been payable to the Executive up to the date of termination of his employment because of death.

iv. In the event of a Change of Control (as defined below) occurs and, if within one (1) year thereafter, the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) A lump sum payment equal to the sum of (i) one (1) year of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination, less applicable withholdings, plus (ii) the Executive's target annual bonus for the year in which the termination occurs, less applicable withholdings, payable at the conclusion of the Review Period (as described below);

b) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) one (1) year or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA; and

c) Payment of a pro-rata portion of the target amount of the Executive's annual bonus, with such pro-rata portion calculated by multiplying the target amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made at the conclusion of the Review Period (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs).

v. In addition, in the event of a Change of Control, notwithstanding anything to the contrary in any applicable option agreement or stock-based award agreement, all time-based stock options and other time-based stock-based awards held by the Executive, to the extent unvested as of immediately prior to the Change of Control shall immediately accelerate and become fully exercisable or nonforfeitable immediately prior to the consummation of the Change of Control.

For purposes of this Agreement, "Change of Control" means (A) the occurrence of a merger or consolidation of the Company whether or not approved by the Board, other than (i) a merger or consolidation which would result in the voting securities of the Company outstanding immediately prior thereto continuing to represent (either by remaining outstanding or by being converted into voting securities of the surviving entity or the parent of such corporation) at least 50% of the total voting power represented by the voting securities of the Company or such surviving entity or parent of such corporation outstanding immediately after such merger or consolidation, or (ii) a merger or consolidation which is in effect a financing transaction for the Company, including, but not limited to, a reverse merger of the Company into a publicly traded "shell" company, or (B) the stockholders of the Company approve an agreement for the sale or disposition by the Company of all or substantially all of the Company's assets, provided that, in any case, "Change of Control" shall be in accordance with Regulation §1.409A-3(i)(5).

vi. Payment of the severance pay and benefits described in Section 4.e.ii. or 4.e.iv., as applicable, is expressly conditioned on the Executive's execution without revocation of the separation agreement and general release described therein, within the time period prescribed in the separation agreement and general release (which release shall include, at the Company's option, a non-competition obligation during any salary

continuation period and (at the Company's option) a revocation period of seven (7) business days), and will commence immediately following a sixty (60) day period following the effective date of the Executive's separation from service from the Company (the "Review Period") (with the exception of the pro rata annual bonus payment described in Section 4.e.ii.b., which shall be payable after the bonus funding level is determined but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs). The separation agreement and general release will be provided to the Executive on or before the fifth (5th) day following such separation from service. If the Executive fails or refuses to return such agreement within the Review Period, the applicable severance payments and benefits will be forfeited. If the Executive is eligible for the severance pay and benefits described in Section 4.e.ii., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.iv. Similarly, if the Executive is eligible for the severance pay and benefits described in Section 4.e.iv., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.ii.

5. Nondisclosure, Non-Solicitation and Assignment Agreement. As a condition of the Executive's employment by the Company and the payment of compensation and receipt of benefits referred to above, the Executive agrees to continue to be bound by the terms of the standard **Nondisclosure, Non-Solicitation and Assignment Agreement**, entered into by the Executive as of 5/2/2008 (the "Nondisclosure Agreement"). The Executive acknowledges that the Company would not offer him employment or provide compensation and/or benefits set forth above if he was not willing to be bound by the terms of such Nondisclosure Agreement.

6. Notice.

a. To the Company. The Executive will send all communications to the Company in writing, addressed as follows (or in any other manner the Company notifies him to use):

Douglas M. Fambrough III, Ph.D. President and CEO
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

With a copy to:

General Counsel
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

b. To the Executive. All communications from the Company to the Executive relating to this Agreement shall be sent to the Executive in writing, at the most recent address on file with the Company.

With a copy to:

Bob D. Brown
57 Grist Mill Road
Littleton, MA 01460

c. Time Notice Deemed Given. Notice shall be deemed to have been given when delivered or, if earlier (1) three business days after mailing by United States certified or registered mail, return receipt requested, postage prepaid, or
(2) sent by overnight mail or delivery with confirmation of delivery, in either case, addressed as required in this section.

7. Amendment. No provisions of this Agreement may be modified, waived, or discharged except by a written document signed by a Company officer duly authorized by the Board and the Executive. A waiver of any conditions or

provisions of this Agreement in a given instance shall not be deemed a waiver of such conditions or provisions at any other time in the future.

8. Choice of Law; Forum Selection. The validity, interpretation, construction, and performance of this Agreement shall be governed by the laws of the Commonwealth of Massachusetts without regard to its conflicts of laws principles. Any claims or legal actions by one party against the other regarding this Agreement shall be commenced and maintained exclusively in any state or federal court located in the Commonwealth of Massachusetts, and the parties hereby submit to the jurisdiction and venue of any such court.

9. Successors. This Agreement shall be binding upon, and shall inure to the benefit of, the Executive and his estate, but the Executive may not assign or pledge this Agreement or any rights arising under it. Without the Executive's consent, the Company may assign this Agreement to any affiliate or to a successor to substantially all the business and assets of the Company.

10. Taxes; Code Sections 409A and 280G.

a. The Company shall withhold taxes from payments it makes pursuant to this Agreement as it reasonably determines to be required by applicable law.

b. If the benefits set forth in Section 4.e. of this Agreement constitute "non-qualified deferred compensation" subject to Section 409A, then the following conditions apply to the payment of such benefits:

i. Any termination of the Executive's employment triggering payment of benefits under Section 4.e. must constitute a "separation from service" under Section 409A(a)(2)(A)(i) of the Code, and Treas. Reg. §1.409A-1(h) before distribution of such benefits can commence. To the extent that the termination of the Executive's employment does not constitute a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h) (as the result of further services that are reasonably anticipated to be provided by the Executive to the Company at the time the Executive's employment terminates), any benefits payable under Section 4.e. that constitute non-qualified deferred compensation under Section 409A shall be delayed until after the date of a subsequent event constituting a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h). For purposes of clarification, this Section shall not cause any forfeiture of benefits on the Executive's part, but shall only act as a delay until such time as a "separation from service" occurs.

ii. If the Executive is a "specified employee" (as that term is used in Section 409A and regulations and other guidance issued thereunder) on the date his separation from service becomes effective, any benefits payable under Section 4.e. that constitute non-qualified deferred compensation subject to Section 409A shall be delayed until the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the date of the Executive's death, but only to the extent necessary to avoid the adverse tax consequences and penalties under Section 409A. On the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the Executive's death, the Company shall pay the Executive in a lump sum the aggregate value of the non-qualified deferred compensation that the Company otherwise would have paid the Executive prior to that date under Section 4.e.

iii. If any amount to be paid to the Executive pursuant to this Agreement is "deferred compensation" subject to Section 409A, then each such payment which is conditioned upon Executive's execution of a release and which is to be paid or provided during a designated period that begins in one taxable year and ends in a second taxable year, shall be paid or provided in the later of the two taxable years.

iv. It is intended that each installment of the payments and benefits provided under Section 4.e. shall be treated as a separate "payment" for purposes of Section 409A.

v. Neither the Company nor the Executive shall have the right to accelerate or defer the delivery of any such payments or benefits except to the extent specifically permitted or required by Section 409A.

c. Notwithstanding any other provision of this Agreement to the contrary, in the event of any ambiguity in the terms of this Agreement, such term(s) shall be interpreted and at all times administered in a manner that avoids the inclusion of compensation in income under Section 409A, or the payment of increased taxes, excise taxes or other penalties under Section 409A.

d. The parties intend this Agreement to be in compliance with Section 409A. Executive acknowledges and agrees that Company does not guarantee the tax treatment or tax consequences associated with any payment or benefit arising under this Agreement, including but not limited to consequences related to Section 409A.

e. If any payment or benefit the Executive would receive under this Agreement, when combined with any other payment or benefit Executive receives pursuant to a Change of Control (whether under this Agreement or otherwise) (such payment or benefit, for purposes of this section, a "Payment") would: (i) constitute a "parachute payment" within the meaning of Section 280G of the Code; and (ii) but for this sentence, be subject to the excise tax imposed by Section 4999 of the Code (the "Excise Tax"), then such Payment shall be either: (A) the full amount of such Payment; or (B) such lesser amount as would result in no portion of the Payment being subject to the Excise Tax, whichever of the foregoing amounts, taking into account the applicable federal, state and local employments taxes, income taxes, and the Excise Tax, results in Executive's receipt, on an after-tax basis, of the greater amount of the Payment notwithstanding that all or some portion of the Payment may be subject to the Excise Tax. The Payments will be reduced in the following order: (A) reduction of any cash severance payments otherwise payable to the Executive that are exempt from Section 409A of the Code; (B) reduction of any other cash payments or benefits otherwise payable to the Executive that are exempt from Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code; (C) reduction of any other payments or benefits otherwise payable to the Executive on a pro-rata basis or such other manner that complies with Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting and payments with respect to any equity awards that are exempt from Section 409A of the Code; and (D) reduction of any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code, in each case beginning with payments that would otherwise be made last in time.

11. Validity. The invalidity or unenforceability of any provision of this Agreement shall not affect the validity or enforceability of any other provision of this Agreement, which shall remain in full force and effect.

12. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original but all of which together shall constitute the same instrument.

13. Entire Agreement; Prior Agreements. This Agreement constitutes the entire agreement among the parties with respect to the subject matter hereof and, unless otherwise provided herein, supersedes all prior agreements, negotiations or understandings, written or oral, in respect thereof.

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Date: 2/21/2020 /s/ Douglas M. Fambrough III, PhD.

By: Douglas M. Fambrough III, Ph.D.
Its: President and CEO

Date: 2/21/2020 /s/ Bob D. Brown.

Bob D. Brown
EVP Research & Development and CSO

Exhibit 10.32

February 21, 2020

Douglas M. Fambrough, III, Ph.D.

Re: Amendment to Employment Agreement

Dear Mr. Fambrough:

This letter agreement (the "Amendment") by and between yourself and Dicerna Pharmaceuticals, Inc. (the "Company") is intended to amend that certain Amended and Restated Employment Agreement between you and the Company, dated July 8, 2016 (the "Agreement"). This Amendment is effective as of February 25, 2020. Capitalized terms used, but not defined herein shall have the meanings given to such terms in the Agreement.

1. Section 4 (e) (ii) (d) of the Agreement is hereby amended and restated in its entirety to read as follows:

   (d) Notwithstanding anything to the contrary in any applicable option agreement or stock-based award agreement, all time-based stock options and other time-based stock-based awards held by the Executive that are scheduled to vest within twelve (12) months following the Executive's date of termination shall accelerate in full upon such termination and shall be exercisable for three (3) months after the date the Executive ceases to be an employee of the Company or within the originally prescribed term of the applicable option, whichever is earlier (but not thereafter).

2. Section 4 (e) (v) (d) of the Agreement is hereby amended and restated in its entirety to read as follows:

   (d) Notwithstanding anything to the contrary in any applicable option agreement or stock-based award agreement, all time-based stock options and other time-based stock-based awards held by the Executive, to the extent unvested as of immediately prior to the termination shall immediately accelerate and become fully exercisable or nonforfeitable immediately prior to the consummation of the termination and shall be exercisable for three (3) months after the date the Executive ceases to be an employee of the Company or within the originally prescribed term of the applicable option, whichever is earlier (but not thereafter).

3. Except as specifically set forth herein, the Agreement and all of its terms and conditions remain in full force and effect, and the Agreement is hereby ratified and confirmed in all respects, except that on or after the date of this Amendment all references in the Agreement to "this Agreement," "hereto," "hereof," "hereunder," or words of like import shall mean the Agreement as amended by this Amendment.

4.This Amendment may be executed in any number of counterparts, each of which shall be deemed an original and such counterparts together shall constitute one and the same instrument.

5.The validity, interpretation, construction, and performance of this Amendment shall be governed by the laws of the Commonwealth of Massachusetts without regard to its conflicts of laws principles. Any claims or legal actions by one party against the other regarding this Amendment shall be commenced and maintained in any state or federal court located in the Commonwealth of Massachusetts, and the parties hereby submit to the jurisdiction and venue of any such court.

6.This Amendment shall be binding upon and inure to the benefit of and be enforceable by the respective successors and assigns of the parties hereto. The Agreement, as amended by this Amendment, embodies the entire agreement and understanding between the parties hereto and supersedes all prior agreements and understandings relating to the subject matter hereof.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

Please sign below to acknowledge your acceptance of the terms of this Amendment.

Very truly yours,

DICERNA PHARMACEUTICALS, INC.

By: /s/ J. Kevin Buchi
Name: J. Kevin Buchi
Title: Chairman

ACKNOWLEDGED, AND AGREED:

/s/ Douglas Fambrough
Name: Douglas M. Fambrough, III, Ph.D.

Dated: 2/21/2020

[Signature Page to Employment Agreement Amendment]

Exhibit 10.33

EMPLOYMENT AGREEMENT (Revised)

EMPLOYMENT AGREEMENT ("Agreement") made this February 21, 2020 (the "Effective Date") between Dicerna Pharmaceuticals, Inc., a Delaware corporation ("Company"), on the one hand and Ralf Rosskamp (the "Executive") on the other hand.

WHEREAS, the Company desires to employ the Executive and the Executive desires to be employed by the Company, on terms set forth herein;

NOW, THEREFORE, in consideration of the mutual agreements set forth herein, the parties agree as follows:

1. Term of Employment. The Executive's employment under this Agreement shall commence on the Effective Date and shall end on such date as the Executive's employment terminates in accordance with Section 4 of this Agreement. Subject to the balance of this Agreement, the Executive shall be an at-will employee of the Company whose employment may be terminated (by the Company or by the Executive) at any time, for any or no reason, in which case the Executive will be entitled to the separation benefits set forth in Section 4, below.

2. Duties. During his employment with the Company, the Executive shall have the title of Chief Medical Officer. The Executive shall devote his full business time and effort to the performance of his duties for the Company, which he shall perform faithfully and to the best of his ability. The Executive shall have all of the customary powers and duties associated with his position and shall be subject to the Company's policies, procedures, and approval practices, as generally in effect from time to time for all senior executives of the Company and the direction and oversight of the Board. The Executive will report directly to the Chief Executive Officer of the Company.

3. Compensation and Related Matters.

a. Base Salary. The Company shall pay the Executive base salary at a rate of $19,788 paid twice monthly (which annualizes to $474,908), less withholdings and deductions required and/or permitted by law. The Executive's base salary shall be paid in conformity with the Company's payroll practices generally applicable to the Company's senior executives.

b. Signing and Annual Bonus. The Company paid the Executive a one-time signing bonus (the "Signing Bonus") of $100,000 (less applicable withholding taxes and deductions) payable within 30 days of the Executive's start date at the Company. The Signing Bonus is subject to the following repayment obligations: as a condition of the Executive's employment with the Company and for receiving the Signing Bonus, the Executive agrees that if, at any time during the twelve months following the Executive's first date of employment with the Company, the Executive (a) resigns his employment with the Company, he shall repay the Signing Bonus, on a pro-rata basis based on length of service; or
(b) the Company terminates the Executive's employment for Cause, he shall repay the Signing Bonus in-full, and in all cases specifically authorize the Company to deduct all of the Signing Bonus required to be repaid from his last paycheck and to the extent that there is a balance still owed by the Executive, he will provide payment of such balance within thirty days (30) of his last date of employment. The Executive shall be eligible to be considered for an Annual Bonus upon achieving of certain pre-determined performance targets consistent with any Incentive Compensation Plan established by the Compensation Committee (the "Committee"). The Annual Bonus shall be based, in part, on the Executive's performance. The grant of such a bonus shall be in the sole discretion of the Committee. The maximum bonus amount for which the Executive will be eligible is forty percent (40%) of base salary earned for the calendar year, provided that, the Annual Bonus for the first year of employment shall be prorated based on the date of hire. The Annual Bonus will be earned only after it has been granted by the Committee. The Annual Bonus shall be paid to the Executive following the close of the fiscal year to which it relates, in no event later than March 15th of the calendar year immediately following the calendar year in which it was earned. The Executive must be actively employed by the Company at the time the Committee considers granting of bonuses to be eligible to receive such bonus.

c. Equity Compensation. Subject to approval of the Board or an appropriate committee thereof, Executive shall be eligible for equity compensation awards, in such amounts and subject to such terms as shall be commensurate with awards granted to other senior executives of the Company.

d. Benefits. During his employment with the Company, the Executive shall be entitled to participate in all employee benefit plans and programs, including paid sick leave and holidays, life insurance, disability, medical, dental, and retirement savings plans, to the same extent generally available to senior executives of the Company, in accordance with the terms of those plans and programs. The Executive shall be permitted up to four weeks of paid vacation per year, which will accrue on a monthly basis. The Executive will not be allowed to accumulate more than three weeks of unused vacation days at any given time. The Executive may carry over a maximum of ten unused vacation days from one calendar year to the next.

e. Expenses. The Company agrees to reimburse the Executive for reasonable out-of-pocket expenses incurred in connection with Company business and within standards to be established by the Board from time to time, including, without limitation, travel and accommodations for authorized business trips, provided vouchers therefor, or other supporting information as the Company may reasonably require, are presented to the Company. All reimbursements provided under this Agreement shall be made or provided in accordance with the requirements of Section 409A of the Internal Revenue Code of 1986, as amended (the "Code") and the rules and regulations thereunder ("Section 409A") including, where applicable, the requirement that (i) any reimbursement is for expenses incurred during the Executive's lifetime (or during a shorter period of time specified in this Agreement); (ii) the amount of expenses eligible for reimbursement during a calendar year may not affect the expenses eligible for reimbursement in any other calendar year; (iii) the reimbursement of an eligible expense shall be made no later than the last day of the calendar year following the year in which the expense is incurred; and (iv) the right to reimbursement or in kind benefits is not subject to liquidation or exchange for another benefit.

4. Termination

a. Rights and Duties. The Executive is an employee "at will." Accordingly, the Company or the Executive may terminate his employment, at any time with or without cause, for any lawful reason, or no reason. The Executive and the Company agree that, without modifying or altering the Executive's "at will" status, each will provide the other with at least thirty (30) days' prior written notice of termination of the Executive's employment with the Company. If the Executive gives notice of termination, except in the case of a termination by the Executive for "Good Reason" as set forth below, such notice will be deemed a voluntary resignation by the Executive and the Company, in its sole discretion, may elect to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, without changing the status of such termination as a voluntary resignation by the Executive. Should the Company in the event of a voluntary resignation decide to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, it shall nonetheless continue his compensation and benefits for the term of the notice period, except that no bonus shall be earned or awarded during and after the notice period.

b. Termination for "Good Reason." The Executive may terminate his employment at any time for "Good Reason." "Good Reason" shall comport with the requirements of Regulation §1.409A-l(n)(2)(ii) and shall mean:

i. A material diminution in the Executive's authority, duties, responsibilities or reporting responsibilities;

ii. A material diminution by the Company of the Executive's annual base compensation then in effect, except a material diminution generally affecting the members of the Company's management;

iii. Any action or inaction by the Company that constitutes a material breach by the Company of the terms of this Agreement; or

iv. A requirement that the Executive be based more than 50 miles from the offices at which he was principally employed immediately prior to the date of termination.

The parties acknowledge and agree that "Good Reason" shall not be deemed to have occurred unless: (1) the Executive provides the Company with written notice that he intends to terminate his employment hereunder for one of the Good Reason grounds set forth in Section 4.b. within sixty (60) days of the initial occurrence of such ground, with such notice containing a description of such ground, (2) if such Good Reason ground is capable of being cured, the Company has failed to cure such ground within a period of thirty (30) days from the date of such written notice, and (3) the

Executive terminates his employment within ninety-one (91) days from the date that such Good Reason ground first occurs. For purposes of clarification, the above-listed conditions shall apply separately to each occurrence of a Good Reason ground, and failure to adhere to such conditions in the event of the occurrence of grounds that would otherwise have constituted Good Reason had the conditions herein been satisfied shall not disqualify the Executive from asserting and satisfying the conditions for Good Reason for any subsequent occurrence that may constitute Good Reason.

c. Termination by the Company for Cause. The Company may terminate the Executive's employment at any time for "Cause." "Cause" shall mean:

i. The Executive's commission of an act of fraud, dishonesty, breach of fiduciary duty or misappropriation which may or does adversely affect the Company;

ii. The Executive's conviction or plea of guilty or *nolo contendere* to or engaging in any felony or crime involving moral turpitude, fraud, misrepresentation or other crime and/or indictment for a crime that, in the reasonable opinion of the Company, affects the Executive's ability to perform the duties set forth in this Agreement and/or reflects negatively upon the Company;

iii. Unauthorized disclosure by the Executive of the Company's Proprietary Information, as defined in the Nondisclosure Agreement (as defined in Section 5 below), which results or could have been reasonably foreseen to result, in a material financial loss to the Company;

iv. The Executive's material breach of this Agreement or the Nondisclosure Agreement; provided, that if such breach is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such breach to cure; or

v. The Executive's failure (which shall not include any Disability as defined below) or refusal to perform the duties and responsibilities of his employment and/or to follow the policies and procedures of the Company, including without limitation the failure or refusal to carry out lawful instructions from the Board. If such failure or refusal is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such failure or refusal to cure.

d. Termination in the Event of Death or Disability. The Agreement shall terminate upon the Executive's death or Disability, and the Executive's employment with the Company shall thereupon terminate. For purposes of the Agreement, "Disability" is defined as any illness, injury, accident or condition of either a physical or psychological nature as a result of which the Executive is unable to perform the essential functions of his duties and responsibilities hereunder for 90 days during any period of 365 consecutive calendar days or for any consecutive 90-day period.

e. Effect of Termination.

i. If the Executive is terminated by the Company for Cause, or by the Executive voluntarily other than for Good Reason, then the Executive will only be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued but unused prior to termination of employment.

ii. If the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) Continuation of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination for a twelve (12) month period, payable in accordance with the Company's regular payroll practices, less applicable withholdings, commencing at the conclusion of the Review Period (as described below), *provided* that the first installment of such payments shall include all amounts which would have been paid during the period between the Executive's date of termination and the date of such first installment;

b) Payment of a pro-rata portion of the actual amount of the Executive's Annual Bonus based on actual performance determined under the terms of the Company's annual bonus program as then in effect,

with such pro-rata portion calculated by multiplying the actual amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made after the determination of the bonus funding level (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs); and

c) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) twelve (12) months or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA.

iii. If the Agreement is terminated because of the Executive's death, the Company shall pay to the estate of the Executive the salary and benefits which would otherwise have been payable to the Executive up to the date of termination of his employment because of death.

iv. In the event of a Change of Control (as defined below) occurs and, if within one (1) year thereafter, the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) A lump sum payment equal to the sum of (i) one (1) year of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination, less applicable withholdings, plus (ii) the Executive's target annual bonus for the year in which the termination occurs, less applicable withholdings, payable at the conclusion of the Review Period (as described below);

b) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) one (1) year or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA; and

c) Payment of a pro-rata portion of the target amount of the Executive's annual bonus, with such pro-rata portion calculated by multiplying the target amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made at the conclusion of the Review Period (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs).

v. In addition, in the event of a Change of Control, notwithstanding anything to the contrary in any applicable option agreement or stock-based award agreement, all time-based stock options and other time-based stock-based awards held by the Executive, to the extent unvested as of immediately prior to the Change of Control shall immediately accelerate and become fully exercisable or nonforfeitable immediately prior to the consummation of the Change of Control.

For purposes of this Agreement, "Change of Control" means (A) the occurrence of a merger or consolidation of the Company whether or not approved by the Board, other than (i) a merger or consolidation which would result in the voting securities of the Company outstanding immediately prior thereto continuing to represent (either by remaining

outstanding or by being converted into voting securities of the surviving entity or the parent of such corporation) at least 50% of the total voting power represented by the voting securities of the Company or such surviving entity or parent of such corporation outstanding immediately after such merger or consolidation, or (ii) a merger or consolidation which is in effect a financing transaction for the Company, including, but not limited to, a reverse merger of the Company into a publicly traded "shell" company, or (B) the stockholders of the Company approve an agreement for the sale or disposition by the Company of all or substantially all of the Company's assets, provided that, in any case, "Change of Control" shall be in accordance with Regulation §1.409A-3(i)(5).

vi. Payment of the severance pay and benefits described in Section 4.e.ii. or 4.e.iv., as applicable, is expressly conditioned on the Executive's execution without revocation of the separation agreement and general release described therein, within the time period prescribed in the separation agreement and general release (which release shall include, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days), and will commence immediately following a sixty (60) day period following the effective date of the Executive's separation from service from the Company (the "Review Period") (with the exception of the pro rata annual bonus payment described in Section 4.e.ii.b., which shall be payable after the bonus funding level is determined but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs). The separation agreement and general release will be provided to the Executive on or before the fifth (5th) day following such separation from service. If the Executive fails or refuses to return such agreement within the Review Period, the applicable severance payments and benefits will be forfeited. If the Executive is eligible for the severance pay and benefits described in Section 4.e.ii., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.iv. Similarly, if the Executive is eligible for the severance pay and benefits described in Section 4.e.iv., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.ii.

5. Nondisclosure, Non-Solicitation and Assignment Agreement. As a condition of the Executive's employment by the Company and the payment of compensation and receipt of benefits referred to above, the Executive agrees to continue to be bound by the terms of the standard **Nondisclosure, Non-Solicitation and Assignment Agreement**, entered into by the Executive as of 5/12/2017 (the "Nondisclosure Agreement"). The Executive acknowledges that the Company would not offer him employment or provide compensation and/or benefits set forth above if he was not willing to be bound by the terms of such Nondisclosure Agreement.

6. Notice.

a. To the Company. The Executive will send all communications to the Company in writing, addressed as follows (or in any other manner the Company notifies him to use):

Douglas M. Fambrough III, Ph.D. President and CEO
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

With a copy to:

General Counsel
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

b. To the Executive. All communications from the Company to the Executive relating to this Agreement shall be sent to the Executive in writing, at the most recent address on file with the Company.

With a copy to:

Ralf Rosskamp
270 Third Street #701
Cambridge, MA 02142

c. Time Notice Deemed Given. Notice shall be deemed to have been given when delivered or, if earlier (1) three business days after mailing by United States certified or registered mail, return receipt requested, postage prepaid, or
(2) sent by overnight mail or delivery with confirmation of delivery, in either case, addressed as required in this section.

7. Amendment. No provisions of this Agreement may be modified, waived, or discharged except by a written document signed by a Company officer duly authorized by the Board and the Executive. A waiver of any conditions or provisions of this Agreement in a given instance shall not be deemed a waiver of such conditions or provisions at any other time in the future.

8. Choice of Law; Forum Selection. The validity, interpretation, construction, and performance of this Agreement shall be governed by the laws of the Commonwealth of Massachusetts without regard to its conflicts of laws principles. Any claims or legal actions by one party against the other regarding this Agreement shall be commenced and maintained exclusively in any state or federal court located in the Commonwealth of Massachusetts, and the parties hereby submit to the jurisdiction and venue of any such court.

9. Successors. This Agreement shall be binding upon, and shall inure to the benefit of, the Executive and his estate, but the Executive may not assign or pledge this Agreement or any rights arising under it. Without the Executive's consent, the Company may assign this Agreement to any affiliate or to a successor to substantially all the business and assets of the Company.

10. Taxes; Code Sections 409A and 280G.

a. The Company shall withhold taxes from payments it makes pursuant to this Agreement as it reasonably determines to be required by applicable law.

b. If the benefits set forth in Section 4.e. of this Agreement constitute "non-qualified deferred compensation" subject to Section 409A, then the following conditions apply to the payment of such benefits:

i. Any termination of the Executive's employment triggering payment of benefits under Section 4.e. must constitute a "separation from service" under Section 409A(a)(2)(A)(i) of the Code, and Treas. Reg.
§1.409A-1(h) before distribution of such benefits can commence. To the extent that the termination of the Executive's employment does not constitute a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h) (as the result of further services that are reasonably anticipated to be provided by the Executive to the Company at the time the Executive's employment terminates), any benefits payable under Section 4.e. that constitute non-qualified deferred compensation under Section 409A shall be delayed until after the date of a subsequent event constituting a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h). For purposes of clarification, this Section shall not cause any forfeiture of benefits on the Executive's part, but shall only act as a delay until such time as a "separation from service" occurs.

ii. If the Executive is a "specified employee" (as that term is used in Section 409A and regulations and other guidance issued thereunder) on the date his separation from service becomes effective, any benefits payable under Section 4.e. that constitute non-qualified deferred compensation subject to Section 409A shall be delayed until the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the date of the Executive's death, but only to the extent necessary to avoid the adverse tax consequences and penalties under Section 409A. On the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the Executive's death, the Company shall pay the Executive in a lump sum the aggregate value of the non-qualified deferred compensation that the Company otherwise would have paid the Executive prior to that date under Section 4.e.

iii. If any amount to be paid to the Executive pursuant to this Agreement is "deferred compensation" subject to Section 409A, then each such payment which is conditioned upon Executive's execution of a release and which is to be paid or provided during a designated period that begins in one taxable year and ends in a second taxable year, shall be paid or provided in the later of the two taxable years.

iv. It is intended that each installment of the payments and benefits provided under Section 4.e. shall be treated as a separate "payment" for purposes of Section 409A.

v. Neither the Company nor the Executive shall have the right to accelerate or defer the delivery of any such payments or benefits except to the extent specifically permitted or required by Section 409A.

c. Notwithstanding any other provision of this Agreement to the contrary, in the event of any ambiguity in the terms of this Agreement, such term(s) shall be interpreted and at all times administered in a manner that avoids the inclusion of compensation in income under Section 409A, or the payment of increased taxes, excise taxes or other penalties under Section 409A.

d. The parties intend this Agreement to be in compliance with Section 409A. Executive acknowledges and agrees that Company does not guarantee the tax treatment or tax consequences associated with any payment or benefit arising under this Agreement, including but not limited to consequences related to Section 409A.

e. If any payment or benefit the Executive would receive under this Agreement, when combined with any other payment or benefit Executive receives pursuant to a Change of Control (whether under this Agreement or otherwise) (such payment or benefit, for purposes of this section, a "Payment") would: (i) constitute a "parachute payment" within the meaning of Section 280G of the Code; and (ii) but for this sentence, be subject to the excise tax imposed by Section 4999 of the Code (the "Excise Tax"), then such Payment shall be either: (A) the full amount of such Payment; or (B) such lesser amount as would result in no portion of the Payment being subject to the Excise Tax, whichever of the foregoing amounts, taking into account the applicable federal, state and local employments taxes, income taxes, and the Excise Tax, results in Executive's receipt, on an after-tax basis, of the greater amount of the Payment notwithstanding that all or some portion of the Payment may be subject to the Excise Tax. The Payments will be reduced in the following order: (A) reduction of any cash severance payments otherwise payable to the Executive that are exempt from Section 409A of the Code; (B) reduction of any other cash payments or benefits otherwise payable to the Executive that are exempt from Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code; (C) reduction of any other payments or benefits otherwise payable to the Executive on a pro-rata basis or such other manner that complies with Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting and payments with respect to any equity awards that are exempt from Section 409A of the Code; and (D) reduction of any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code, in each case beginning with payments that would otherwise be made last in time.

11. Validity. The invalidity or unenforceability of any provision of this Agreement shall not affect the validity or enforceability of any other provision of this Agreement, which shall remain in full force and effect.

12. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original but all of which together shall constitute the same instrument.

13. Entire Agreement; Prior Agreements. This Agreement constitutes the entire agreement among the parties with respect to the subject matter hereof and, unless otherwise provided herein, supersedes all prior agreements, negotiations or understandings, written or oral, in respect thereof.

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DICERNA PHARMACEUTICALS, INC.

Date: 2/21/2020 /s/ Douglas M. Fambrough III, PhD.

By: Douglas M. Fambrough III, Ph.D.
Its: President and CEO

Date: 2/26/2020 /s/ Ralf Rosskamp

Ralf Rosskamp
Chief Medical Officer

Exhibit 10.46

CERTAIN INFORMATION IDENTIFIED BY BRACKETED ASTERISKS ([* * *]) HAS BEEN OMITTED FROM THIS EXHIBIT BECAUSE IT IS BOTH NOT MATERIAL AND WOULD BE COMPETITIVELY HARMFUL IF PUBLICLY DISCLOSED.

EXECUTION COPY
Confidential

Collaboration and License Agreement

This Agreement, dated as of October 30, 2019, is entered into by and between

F. Hoffmann-La Roche Ltd
with an office and place of business at Grenzacherstrasse 124, 4070 Basel, Switzerland ("**Roche Basel**")

and

Hoffmann-La Roche Inc.
with an office and place of business at 150 Clove Road, Suite 8, Little Falls, New Jersey 07424, U.S.A. ("**Roche US**"; Roche Basel and Roche US together referred to as "**Roche**")

on the one hand

and

Dicerna Pharmaceuticals, Inc.
with an office and place of business at 33 Hayden Avenue, Lexington, Massachusetts 02421, U.S.A. (**"Dicerna**")

on the other hand.

Table of Contents

Collaboration and License Agreement

WHEREAS, Dicerna is the owner of a proprietary RNAi technology platform designated as GalXC™ which advances the development of next-generation RNAi-based therapies that act by silencing disease-driving genes in the liver;

WHEREAS, Dicerna has utilized the GalXC™ platform to create potential RNAi therapies for treating hepatitis B virus including a lead molecule currently in a Phase I clinical study;

WHEREAS, Roche has expertise in the research, development, manufacture and commercialization of pharmaceutical products and has an active program in the discovery and development of oligonucleotide therapeutics intended for the treatment of hepatitis B virus;

WHEREAS, Roche and Dicerna wish to collaborate in the research and development of oligonucleotide therapeutics for the treatment of hepatitis B virus;

WHEREAS, Roche desires to commercialize such therapeutics, with Dicerna retaining options for (i) the sharing of the costs of development, in exchange for increased royalty rates for Roche's sales, of the lead molecule in the United States and (ii) the co-promotion of the lead compound in the United States; and,

WHEREAS, Dicerna is willing to grant to Roche rights to use certain of its intellectual property rights to make, use, offer for sale, sell and import and export Compounds and Products (as such terms are respectively defined below), as contemplated herein.

NOW, THEREFORE, in consideration of the mutual covenants and promises contained in this Agreement and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties hereto, intending to be legally bound, do hereby agree as follows:

1. Definitions

As used in this Agreement, the following terms, whether used in the singular or plural, shall have the following meanings:

1.1 Accounting Standard

The term “Accounting Standards” shall mean: (i) with respect to Roche, its Affiliates or its Sublicensee, either IFRS or United States generally accepted accounting principles (GAAP), in either case, as currently used at the applicable time by, and as consistently applied by, such applicable entity; or (ii) with respect to Dicerna or its Affiliates, United States generally accepted accounting principles (GAAP), as currently used at the applicable time by, and as consistently applied by, such applicable entity.

1.2 Additional Dicerna Compound

The term “Additional Dicerna Compound” shall mean any GalXC Molecule (a) arising out of (or provided by either Party or its Affiliates into) the R&D Collaboration, or any derivative, modification or backup compound thereof, that is Directed To a Selected Target or (b) that is a derivative, modification or backup compound of the Lead Compound. If a Selected Target is terminated or becomes a Discontinued Target, Additional Dicerna Compounds Directed To such Selected Target shall only retain the status of Additional Dicerna Compounds for purposes of the provisions of Article 20 (however subject to Section 20.3.4 in the event of Compulsory Sublicense or Sublicensee rights).

1.3 Affiliate

The term “Affiliate” shall mean any individual, corporation, association or other business entity that directly or indirectly controls, is controlled by, or is under common control with the Party in question. As used in this definition of “Affiliate,” the term “control” shall mean the direct or indirect ownership of more than fifty percent (>50%) of the stock having the right to vote for directors thereof or the ability to otherwise control the management of the corporation or other business entity whether through the ownership of voting securities, by contract, resolution, regulation or otherwise. Anything to the contrary in this paragraph notwithstanding, Chugai Pharmaceutical Co., Ltd, a Japanese corporation (“**Chugai**”) and/or its subsidiaries (if any) shall not be deemed as Affiliates of Roche unless Roche provides written notice to Dicerna of its desire to include Chugai and/or its respective subsidiaries (as applicable) as Affiliate(s) of Roche.

1.4 Agreement

The term “Agreement” shall mean this document including any and all appendices and amendments to it as may be added and/or amended from time to time in accordance with the provisions of this Agreement.

1.5 Agreement Term

The term “Agreement Term” shall mean the period of time commencing on the Effective Date and, unless this Agreement is terminated sooner as provided in Article 20, expiring on a Product-by-Product basis on the date when no royalty or other payment obligations under this Agreement are or will become due.

1.6 Applicable Law

The term “Applicable Law” shall mean any law, statute, ordinance, code, rule or regulation that has been enacted by a government authority (including any Regulatory Authority) and is in force as of the Effective Date or comes into force during the Agreement Term, in each case to the extent that the same is applicable to the performance by the Parties of their respective obligations or the Parties’ other activities under this Agreement.

1.7 Available Target
The term “Available Target” shall mean, with respect to a given target, the Gatekeeper’s good faith belief that a license to Roche is available under Patent Rights Controlled by Dicerna for compounds Directed To (i) a proposed Host Cell Factor Target because such proposed Host Cell Factor Target is not on the list of Not Available Targets and such license is available for the Limited Field or, (ii) a proposed Viral Target, because such proposed Viral Target is a Viral Target and such license is available in the Field.

1.8 Biosimilar Product
The term “Biosimilar Product” shall mean, with respect to a Product, a product that (i) is not produced, licensed or owned by the Roche Group, (ii) as determined by the relevant Regulatory Authority for the given country or jurisdiction, is highly similar with respect to such Product, notwithstanding minor differences in clinically inactive components, and with no clinically meaningful differences between the product and such Product in terms of the safety, purity and potency, and (iii) is approved through an abbreviated regulatory pathway.

For countries or jurisdictions where no explicit biosimilar regulations exist, a Biosimilar Product includes any product that (i) has been deemed to be biosimilar to such Product by a Regulatory Authority in another country or jurisdiction or (ii) have the same nucleic acid sequence as the Compound in such Product.

1.9 Business Day
The term “Business Day” shall mean 9.00am to 5.00pm local time on a day other than a Saturday, Sunday or other day on which commercial banking institutions in New York, New York and Boston, Massachusetts are authorized or permitted by law to be closed.

1.10 Calendar Quarter
The term “Calendar Quarter” shall mean each period of three (3) consecutive calendar months, ending March 31, June 30, September 30, and December 31.

1.11 Calendar Year
The term “Calendar Year” shall mean each period of twelve (12) months beginning on January 1 and ending December 31, except for the first year which shall begin on the Effective Date and end on December 31.

1.12 cGLP
The term “cGLP” shall mean the current Good Laboratory Practices, including, as applicable: (a) guidelines provided by the International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use (ICH), (b) the requirements in Part 58 of Title 21 of the Code of Federal Regulations and all related guidance published by the FDA and (c) as required by other Applicable Law in applicable countries not subject to (a) and (b) where data from non-clinical studies conducted in other countries may be used to obtain Regulatory Approval, provided that to the extent applicable to Dicerna, such additional requirements not otherwise required under clauses (a) and (b) are set forth in an applicable Research Plan.

1.13 Change of Control
The term “Change of Control” shall mean, with respect to a Party: (a) the acquisition by any Third Party of beneficial ownership of fifty percent (50%) or more of the then outstanding common shares

or voting power of such Party, other than acquisitions by employee benefit plans sponsored or maintained by such Party; (b) the consummation of a business combination involving such Party, unless, following such business combination, the stockholders of such Party immediately prior to such business combination beneficially own directly or indirectly more than fifty percent (50%) of the then outstanding common shares or voting power of the entity resulting from such business combination; or (c) the sale of all or substantially all of such Party's assets or business relating to the subject matter of the Agreement.

1.14 Change of Control Group
The term "Change of Control Group" shall mean with respect to a Party, the person or entity, or group of persons or entities, that is the acquirer of, or a successor to, a Party in connection with a Change of Control, together with affiliates of such persons or entities that are not Affiliates of such Party immediately prior to the completion of such Change of Control of such Party.

1.15 Clinical Candidate
The term "Clinical Candidate" shall mean a Compound formally selected by the JRC during the Target Term, using criteria set forth in the applicable Research Plan, in preparation for cGLP toxicology and other studies that are required to be carried out in order to obtain Regulatory Approval for an initial Clinical Study for such Compound.

1.16 Clinical Study
The term "Clinical Study" shall mean a Phase I Study, Phase II Study, Phase III Study or Post-Approval Commitment Study, as applicable.

1.17 Combination Product
The term "Combination Product" shall mean

(a) a single pharmaceutical formulation containing as its active ingredients both a Compound and one or more Non-Compound Active Agents, or

(b) a combination therapy comprised of a Compound and one or more Non-Compound Active Agents, priced and sold in a single package containing such multiple products or packaged separately but sold together for a single price,

in each case, including all dosage forms, formulations, presentations, line extensions, and package configurations. All references to Product in this Agreement shall be deemed to include Combination Product.

1.18 Commercialization
The term "Commercialization" shall mean any and all activities directed to the preparation for the sale of, offering for sale or sale of a Product, including activities relating to marketing, promoting, distributing and importing such Product. When used as a verb, to "**Commercialize**" and "**Commercializing**" means to engaged in Commercialization, and "**Commercialized**" has a corresponding meaning. For clarity, "**Commercialization**" shall not include any research or Development activities.

1.19 Commercialization Plan
The term "Commercialization Plan" shall mean a commercialization plan and budget for the Co-Promotion Territory prepared by Roche and provided to Dicerna with respect to Shared Products that are subject to the Co-Promotion Option or are Co-Promotion Products that will include: (i) sales force and launch planning for Shared Products (to the extent applicable), (ii) marketing plans and budget.

For Co-Promotion Products, the Parties (including through the JSC, as applicable) will review the Commercialization Plan from time to time as necessary for the purpose of considering appropriate amendments thereto; provided that (a) such review shall occur no less frequently than once every six (6) months, (b) Roche shall make appropriate representatives available to discuss and answer questions concerning the Commercialization Plan with Dicerna at least twice annually upon Dicerna's reasonable request in accordance with Section 7.12. In addition, either Party, through its representatives on the JSC (to the extent applicable), may propose amendments to the Commercialization Plan for Co-Promotion Products at any time.

1.20 Commercially Reasonable Efforts
[* * *]

1.21 Committee
The term "Committee" shall mean the JRC or the JSC.

1.22 Companion Diagnostic
The term "Companion Diagnostic" shall mean any product or service that:

(a) identifies a person having a disease or condition, or a molecular genotype or phenotype that predisposes a person to such disease or condition, for which a Product could be used to treat and/or prevent such disease or condition;

(b) defines the prognosis or monitors the progress of a disease or condition in a person for which a Product could be used to treat and/or prevent such disease or condition;

(c) is used to select a therapeutic or prophylactic regimen, wherein at least [* * *] potential therapeutic or prophylactic regimen involves a Product, and where the selected regimen is determined, based on the use of such product or service, to likely be effective and/or to be safe for a person; and/or

(d) is used to confirm a Product's biological activity and/or to optimize dosing or the scheduled administration of a Product.

1.23 Competitor
[* * *]

1.24 Complete or Completion
The term "Complete" or "Completion" shall mean the availability of the final formal written report in relation to a Clinical Study setting out a final assessment of the results and conclusion of such Clinical Study.

1.25 Composition of Matter Claim
The term "Composition of Matter Claim" shall mean, for a given Product in a given country of the Territory, a Valid Claim that Covers the composition of matter of the Compound *per se*, or the composition of matter of the Product comprising the Compound plus unspecified pharmaceutically-acceptable excipients. For clarity, a Compound may include an oligonucleotide sequence capable of providing a guide strand that inhibits or prevents the expression or translation of viral or host cell factor genes in a human host.

1.26 Compound
The term "Compound" shall mean any Dicerna Compound or Roche Compound.

1.27 Compulsory Sublicense Compensation
The term “Compulsory Sublicense Compensation” shall mean, for a given country or region in the Territory, the compensation paid to Roche by a Third Party (a “**Compulsory Sublicensee**”) under a license or sublicense of applicable Licensed IP, Joint Patent Rights or Roche Patent Rights granted to the Compulsory Sublicensee (the “**Compulsory Sublicense**”) through the order, decree or grant of a governmental authority having competent jurisdiction in such country or region, authorizing such Third Party to manufacture, use, sell, offer for sale, import or export a Product in such country or region.

1.28 Confidential Information
The term “Confidential Information” shall mean any and all information, data or know-how (including Know-How), whether technical or non-technical, oral or written, that is disclosed by one Party or its Affiliates (“**Disclosing Party**”) to the other Party or its Affiliates (“**Receiving Party**”). Confidential Information shall not include any information, data or know-how that:

(i) was generally available to the public at the time of disclosure, or becomes available to the public after disclosure by the Disclosing Party other than through fault (whether by action or inaction) of the Receiving Party or its Affiliates,

(ii) can be evidenced by written records to have been already known to the Receiving Party or its Affiliates prior to its receipt from the Disclosing Party,

(iii) is obtained at any time lawfully from a Third Party under circumstances permitting its use or disclosure,

(iv) is developed independently by the Receiving Party or its Affiliates as evidenced by written records that evidence such development without the knowledge of the Confidential Information transferred hereunder, or

(v) is approved in writing by the Disclosing Party for release by the Receiving Party.

The terms of this Agreement shall be considered Confidential Information of the Parties.

1.29 Continuation Election Notice
The term “Continuation Election Notice” shall mean the notice Dicerna provides to Roche under Section 20.3.2 or 20.3.3 describing (i) Dicerna’s *bona fide* intentions to continue ongoing Development and Commercialization of applicable Licensed Product(s) and (ii) Dicerna’s request for Roche’s continuation of activities during the termination period and/or transfer of the data, material and information relating to the applicable Licensed Product(s) in accordance with Section 20.3.2 or 20.3.3.

1.30 Control
The term “Control” shall mean (as an adjective or as a verb including conjugations and variations such as “Controls” “Controlled” or “Controlling”) (a) with respect to Patent Rights and/or Know-How, the possession by a Party of the ability to grant a license or sublicense of such Patent Rights and/or Know-How without violating the terms of any agreement or arrangement between such Party and any other party and (b) with respect to proprietary materials, the possession by a Party of the ability to supply such proprietary materials to the other Party as provided herein without violating the terms of any agreement or arrangement between such Party and any other party. Notwithstanding anything in this Agreement to the contrary, in the event of a Change of Control of a Party, such Party shall be deemed to not own or Control any intellectual property right that is owned or Controlled by the Change of Control Group except to the extent the Change of Control Group intermingles its intellectual property with the Party’s intellectual property.

1.31 Co-Promotion Exercise Period
The term “Co-Promotion Exercise Period” shall mean, with respect to a Shared Product, the period commencing upon Dicerna’s exercise of its Cost Share Option and ending upon the later of (i) [* * *] after Roche provides Dicerna with the Roche Estimate pursuant to Section 10.6.2(a) and (ii) [* * *] after the Roche Response Date (if Dicerna provides timely Shared Product Questions).

1.32 Co-Promotion Product
The terms “Co-Promotion Product” shall mean a Shared Product for which Dicerna has a Co-Promotion Right as of the applicable time.

1.33 Co-Promotion Territory
The terms “Co-Promotion Territory” shall mean the US.

1.34 Cost of Manufacture
The term “Cost of Manufacture” shall mean:

(a) When a Party Manufactures directly, the sum of: (i) the cost (as defined in each such Party's Accounting Standards consistently applied) to Manufacture a Shared Product (or potential Shared Product), including items such as cost of materials, yield and waste levels, direct labor, etc.; (ii) any additional applicable overhead, including items such as costs that relate to such Party’s supervisory, occupancy, facility and equipment, etc., as calculated according to and consistent with such Party’s internal policies; (iii) other such costs burdened to the product due to Manufacturing (including inventory write-offs and excess capacity charges to the extent not exceeding [* * *]); and (iv) the actual costs associated with the technology transfer to a CMO to enable Manufacturing of that product, including any upfront and milestone based payments and startup costs allocable to the Shared Product that are associated therewith. All Cost of Manufacture shall be consistently applied to the product for ongoing clinical trials.

(b) When a Party uses a CMO to Manufacture a Shared Product, the amount actually paid to (and not reimbursed by) each such CMO, including FTE costs associated with overseeing any CMO.

1.35 Cover
The term “Cover” shall mean (as an adjective or as a verb including conjugations and variations such as “Covered,” “Coverage” or “Covering”) that the developing, making, using, offering for sale, promoting, selling, exporting or importing of a given compound, formulation or product would infringe a Valid Claim in the absence of a license under or ownership in the Patent Rights to which such Valid Claim pertains. The determination of whether a compound, formulation, process or product is Covered by a particular Valid Claim shall be made on a country-by-country basis.

1.36 CTA
The term “CTA” shall mean a submission made to the applicable Regulatory Authority, the purpose of which is to gain necessary clearance, licensure or approval by such agency to lawfully distribute a product to perform a human clinical trial of such product that at the time of such submission is not otherwise lawfully able to be distributed or marketed under the Applicable Laws of the relevant jurisdiction. CTAs include the CTAs approved by the EMA or Health Canada, investigational new drug applications (“**IND**”) as defined in the FDCA and applicable regulations promulgated by the FDA, or the equivalent application to the equivalent agency in any other country or group of countries, the filing of which is necessary to commence clinical testing of the Products in humans.

1.37 Detail

The term “Detail” shall mean a one-on-one face-to-face contact in which a Sales Representative makes a presentation, including selling message and features and benefits of the Product to a professional having prescribing authority. E-details and presentations made at conventions or similar gatherings will not constitute a Detail. Sample drops (if applicable) and reminder details shall not constitute a Detail. Attendance at group meetings or other group situations shall only be considered a single Detail regardless of the number of participants. For the avoidance of doubt, Details may occur in group situations if the definition of a Detail is met. When used as a verb, “**Detailing**” shall mean to engage in the activities set forth herein.

1.38 Development

The term “Development” shall mean all activities undertaken by or on behalf of any Roche Group member on and after the Initiation of GLP Tox Study to develop a Compound or a Product including cGLP studies, manufacturing process and drug product (dosage form) development, conducting toxicology studies, clinical testing and all Clinical Studies (including approved investigator sponsored studies), statistical analysis and report writing, regulatory affairs and clinical regulatory activities. For further avoidance of doubt, Development does not include activities undertaken by or on behalf of a Party under the R&D Collaboration. When used as a verb, to “**Develop**” and “**Developing**” means to engage in Development, and “**Developed**” has a corresponding meaning.

1.39 Development Costs

The term “Development Costs” shall mean the global costs actually incurred, including FTE Costs and any direct out-of-pocket costs or expenses paid or accrued in accordance with Accounting Standards, by any Roche Group member for Development of a Shared Product (or potential Shared Product) including studies of the clinical aspects conducted internally or by individual investigators, or consultants necessary for the purpose of obtaining, maintaining and/or expanding marketing approval of such Shared Product, process development, process improvement and recovery costs, failed clinical lots, qualification lots, costs for preparing, submitting, reviewing or developing data or information for the purpose of submission to a governmental authority to obtain, maintain and/or expand marketing approval of such Shared Product. Development Costs shall not include costs associated with Companion Diagnostics. The Development Costs shall also include expenses for data management, CROs, statistical designs and studies, documentation preparation and other administration expenses associated with the clinical testing program or Post-Approval Commitment Studies and Cost of Manufacture for clinical supply of such Shared Product. By way of example, Development Costs may include costs in connection with the following activities:

(a) Clinical Studies (for clarity including Post-Approval Commitment Studies but excluding Marketing Studies and Phase IV Studies) for such Shared Products, including (i) the preparation for and conduct of clinical trials (except clinical trials that are solely conducted for regulatory requirements specific to a particular country or territory outside the US); (ii) data collection, management and analysis and report writing; (iii) clinical laboratory work; (iv) advisory meetings in connection with such Shared Products; and (v) Regulatory Expenses in direct connection with Clinical Studies for such Shared Products;

(b) CMC-related Development activities, including activities relating to the development and establishment of the clinical and commercial manufacturing process for such Shared Products and establishment of the supply chain; and

(c) Cost of Manufacture for such Shared Products or other drug or product or other materials used for such Shared Products, including combination agents and comparators.

1.40 Development Plan
The term “Development Plan” shall mean Roche’s development plan for the Lead Product, the scope and level of detail of which shall be consistent with the standards Roche applies to its internal programs at a similar stage of development.

1.41 Dicerna Base Patent Rights
The term “Dicerna Base Patent Rights” shall mean the Patent Rights listed in Appendix 1.41 of this Agreement.

1.42 Dicerna Compound
The term “Dicerna Compound” shall mean

(a) any Additional Dicerna Compounds, and

(a) any GalXC Molecules owned or Controlled by Dicerna Directed To HBV other than Additional Dicerna Compounds, including

(i) the Lead Compound, and

(ii) any derivative, modification or backup compound to the Lead Compound.

in both cases excluding a Roche Compound.

1.43 Dicerna GalXC Platform Patent Rights
The term “Dicerna GalXC Platform Patent Rights” shall mean Patent Rights owned or Controlled (other than by license from the Roche Group under this Agreement) by Dicerna or its Affiliates, prior to or during the Agreement Term, that are reasonably necessary or useful to research, have researched, develop, have developed, make, have made, use, have used, register, have registered, sell, have sold, offer for sale, import or export GalXC Molecules and claim the GalXC Platform or the use or manufacture thereof, but however do not claim exclusively (i) Compounds, targets or associated sequences/constructs, in each case Directed To HBV or (ii) the use or manufacture of such Compounds or targets. Dicerna GalXC Platform Patent Rights as of the Effective Date are listed in Appendix 1.43 of this Agreement.

1.44 Dicerna Phase I Study
The term “Dicerna Phase I Study” shall mean the Phase I Study for the Lead Compound that Dicerna has commenced but not yet Completed as of the Signature Date, as well as the Optional Phase I Cohorts(s) if applicable.

1.45 Directed To
The term “Directed To” shall mean with regard to an RNAi product or oligonucleotide product and target, [* * *]. For clarity, if the defined term “Directed To” is separated, such as when required grammatically (*e.g.*, when discussing targets “To which a product is Directed”), such separated term shall maintain the same meaning set forth in the previous sentence.

1.46 Discontinued Target
The term “Discontinued Target” shall mean a target that has been designated as such in accordance with Sections 3.8, 20.2.4 or 20.2.5.

1.47 Effective Date
The term “Effective Date” is defined in Section 22.4.

1.48 EMA
The term “EMA” shall mean the European Medicines Agency or any successor agency with responsibilities comparable to those of the European Medicines Agency.

1.49 Encumbered Combination Agent
The term “Encumbered Combination Agent” shall mean an active ingredient in a Combination Product that is not a Compound and that (i) is subject to Third Party rights or obligations granted from or to the Roche Group or (ii) directly competes with a product under clinical development or commercialization by Dicerna.

1.50 Encumbered Combination Indication
The term “Encumbered Combination Indication” shall mean, with respect to a Co-Promotion Product that is a Combination Product containing an active ingredient that is not a Compound, an indication for which Regulatory Approval is obtained with respect to which Roche has granted to a Third Party co-promotion or other rights.

1.51 EU
The term “EU” shall mean the European Union and all its then-current member countries but including in any case France, Germany, Italy, Spain and the United Kingdom regardless of whether they are then-current member countries.

1.52 Excluded Claim
The term “Excluded Claim” shall mean a dispute, controversy or claim between the Parties that concerns (a) the validity or infringement, scope, enforceability or inventorship of a patent, trademark or copyright, or (b) any antitrust, anti-monopoly or competition Applicable Law, whether or not statutory.

1.53 Excluded Dicerna Patent Right
The term “Excluded Dicerna Patent Right” shall mean a claim in a Patent Right owned or Controlled by Dicerna to the extent that such claim exclusively claims a Non-Compound Active Agent, alone or in combination with other molecular entities, none of which can be Compounds. For clarity, if a claim in a Patent Right Controlled by Dicerna lists a molecular entity that is a Compound, then such Patent Right is not an Excluded Dicerna Patent Right.

1.54 Exclusivity Period
The term “Exclusivity Period” shall mean the period of time commencing on the Effective Date and ending the earlier of the non-initiation, expiration or earlier termination of the R&D Collaboration. For clarity, if the R&D Collaboration does not commence, the Exclusivity Period for both Parties will end as of the earlier of date of the notice of termination of the Agreement or the date of Roche’s notice that Roche elects not to initiate the R&D Collaboration.

1.55 Ex-Limited Licensee
The term “Ex-Limited Licensee” shall mean Third Parties (and their respective sublicensees, successor or assigns) to whom Dicerna has granted as of the Signature Date rights imposing PN Field Restrictions.

1.56 Expert

The term “Expert” shall mean a person with no less than [* * *] of pharmaceutical industry experience and expertise having occupied at least one senior position within a large pharmaceutical company relating to product commercialization and/or licensing but excluding any current or former employee or consultant of either Party. Such person shall be fluent in the English language.

1.57 Extraordinary Event
The term “Extraordinary Event” shall mean Development Costs associated with any of the following activities that were not anticipated in a given Annual Budget and the then current Development Plan: (i) faster than planned Clinical Study enrollment, (ii) written guidance or requirements from a Regulatory Authority that would result in amendments to the Development Plan, (iii) technical issues affecting the ability to supply clinical material of Compound or Product or (iv) mutual agreement by the Parties to amend the Development Plan.

1.58 FDA
The term “FDA” shall mean the Food and Drug Administration of the United States of America.

1.59 FDCA
The term “FDCA” shall mean the Food, Drug and Cosmetics Act.

1.60 Field
The term “Field” shall mean all uses.

1.61 Filing
The term “Filing” shall mean the filing of an application by the FDA as defined in the FDCA and applicable regulations, or the equivalent application to the equivalent agency in any other country or group of countries including MAA by the EMA, the official approval of which is required before any lawful commercial sale or marketing of Products.

1.62 Finalized
The term “Finalized” shall mean the applicable Clinical Study has been fully enrolled with the last enrolled patient receiving the last dose of Product pursuant to the study protocol and the draft clinical study report including listings and tables are available.

1.63 First Commercial Sale
The term “First Commercial Sale” shall mean, on a country-by-country basis, the first invoiced sale of a Product to a Third Party by the Roche Group following the receipt of any Regulatory Approval required for the sale of such Product, or if no such Regulatory Approval is required, the date of the first invoiced sale of a Product to a Third Party by the Roche Group in such country.

1.64 FTE
The term “FTE” shall mean with respect to a person, the equivalent of the work of [* * *] employee full time for [* * *] (consisting of [* * *] per Calendar year excluding vacations and holidays), or such other period as may be prescribed by Applicable Law, on a country-by-country basis. Overtime, work on weekends, holidays and the like will not be counted with any multiplier (e.g. time-and-a-half or double time) toward the number of hours that are used to calculate the FTE contribution.

1.65 FTE Costs

The term “FTE Costs” shall mean Roche’s or Dicerna’s FTE rate, assessed consistent with internal Accounting Standards, multiplied by the applicable number of FTEs of Roche or its Affiliates or Dicerna or its Affiliates, as applicable, performing the applicable activities during such period multiplied by the applicable percentage of time such FTEs have performed the applicable activities during such period.

1.66 Gatekeeper
The term “Gatekeeper” shall mean an independent outside counsel appointed by Dicerna responsible for conducting the Gatekeeper Process, through which Roche may directly inquire as to whether any proposed target is an Available Target or Not Available Target.

1.67 Gatekeeper Process
The term “Gatekeeper Process” shall mean the processes described in Section 3.7 to be used for target nomination or target reservation.

1.68 GalXC Molecule
The term “GalXC Molecule” shall mean [* * *].

1.69 GalXC Platform
The term "GalXC Platform" shall mean [* * *].

1.70 GalXC Platform Improvements
The term “GalXC Platform Improvements” shall mean [* * *].

1.71 Genentech
The term “Genentech” shall mean Genentech, Inc. for so long as Genentech is an Affiliate of Roche.

1.72 Genentech Patent Right
The term “Genentech Patent Right” shall mean Patent Rights claiming inventions based on projects originating from the Genentech early development organization made by or on behalf of Genentech employees (with or without Third Parties). As of the Signature Date, as between the Roche Group Affiliates, Genentech Patent Rights are owned by Genentech in the US and Roche Basel outside the US.

1.73 Generic Product
The term “Generic Product” shall mean, with respect to a Product, a product that (i) is not produced, licensed or owned by the Roche Group, (ii) contains a pharmaceutically active ingredient that is the same as any Compound in such Product, (iii) has the same or substantially the same labelling as the applicable Product for at least one indication of such Product, and (iv) is approved through an abbreviated regulatory pathway, to the extent one exists in a given country.

1.74 Handle
The term “Handle” shall mean preparing, filing, prosecuting (including interferences, reissue, re-examination, post-grant reviews, *inter-partes* reviews, derivation proceedings and opposition proceedings) and maintaining.

1.75 HBV
The term “HBV” shall mean hepatitis B virus.

1.76 Host Cell Factor Target

The term “Host Cell Factor Target” shall mean [* * *]:

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1.77 Hybrid Product
The term “Hybrid Product” shall mean a Product, on a country-by-country basis, that contains (i) a Lead Compound where such Lead Compound has already been included in a Lead Product that has achieved its First Commercial Sale in such country as a Product not containing a Selected Target Compound and (ii) at least one Selected Target Compound.

1.78 IFRS
The term “IFRS” shall mean International Financial Reporting Standards.

1.79 Improvement
The term “Improvement” shall mean, any Invention which is [* * *].

1.80 Initiation
The term “Initiation” shall mean the date that a human is first dosed with the Product in a Clinical Study approved by the respective Regulatory Authority.

1.81 Initiation of GLP Tox Study
The term “Initiation of GLP Tox Study” shall mean, with respect to a Compound or Product, the date that the first animal is first dosed with such Compound or Product in a study of the relationship between dose and its effects on the exposed animal, where (i) the study is conducted in accordance with cGLP standards and (ii) the study is intended to support establishment of a safe starting dose of the Compound or Product in human Clinical Studies.

1.82 Insolvency Event
The term “Insolvency Event” shall mean circumstances under which a Party (i) has a receiver or similar officer appointed over all or a material part of its assets or undertaking; (ii) passes a resolution for winding-up (other than a winding-up for the purpose of, or in connection with, any solvent amalgamation or reconstruction) or a court makes an order to that effect or a court makes an order for administration (or any equivalent order in any jurisdiction); (iii) enters into any composition or arrangement with its creditors (other than relating to a solvent restructuring); (iv) ceases to carry on business; (v) is unable to pay its debts as they become due in the ordinary course of business.

1.83 Internal Revenue Code
The term “Internal Revenue Code” shall mean the US Internal Revenue Code of 1986, as amended.

1.84 Invention
The term “Invention” shall mean an invention, whether or not patentable, that is conceived or reduced to practice in connection with any activity carried out pursuant to this Agreement. Under this definition, an Invention may be made by employees of Dicerna solely or jointly with a Third Party (a “**Dicerna Invention**”), by employees of the Roche Group solely or jointly with a Third Party (a “**Roche Invention**”), or jointly by employees of Dicerna and employees of the Roche Group with or without a Third Party (a “**Joint Invention**”).

1.85 Joint Know-How

The term “Joint Know-How” shall mean Know-How that is made jointly by employees of Dicerna and the Roche Group, with or without a Third Party in connection with any activity carried out pursuant to this Agreement.

1.86 Joint Patent Rights
The term “Joint Patent Rights” shall mean all Patent Rights Covering a Joint Invention other than GalXC Platform Improvements or Roche Background Improvements.

1.87 JOT
The term “JOT” shall mean a joint operating team (or Joint Project Team) described in Section 7.10.

1.88 JRC
The term “JRC” shall mean the joint research committee described in Section 7.1.

1.89 JSC
The term “JSC” shall mean the joint steering committee described in Section 7.2.

1.90 Know-How
The term “Know-How” shall mean data, knowledge and information, including materials, samples, chemical manufacturing data, toxicological data, pharmacological data, preclinical and clinical data, assays, platforms, formulations, specifications, quality control testing data, that are confidential and necessary or useful for the discovery, manufacture, development or commercialization of Products.

1.91 Lead Compound
The term “Lead Compound” shall mean the molecule designated as DCR-S219, the structure of which is listed in Appendix 1.91 of this Agreement.

1.92 Lead Product
The term “Lead Product” shall mean any Product containing the Lead Compound and does not include a Selected Target Compound.

1.93 Licensed IP
The term “Licensed IP” shall mean all Patent Rights and Know-How Controlled by Dicerna or its Affiliates (other than by license from the Roche Group under this Agreement), prior to or during the term of the Agreement, necessary or useful to research, have researched, develop, have developed, make, have made, use, have used, register, have registered, sell, have sold, offer for sale, import or export Compounds and/or Products in the Field, including Dicerna Base Patent Rights and Dicerna GalXC Platform Patent Rights, but excluding Excluded Dicerna Patent Rights.

1.94 Licensed Product
The term “Licensed Product” shall mean any product, including any Combination Product, containing a Dicerna Compound as a pharmaceutically active ingredient, regardless of their finished forms or formulations or dosages. One Licensed Product may be distinguished from another Licensed Product by the Dicerna Compound being a distinctive active pharmaceutical ingredient.

1.95 Like-Substance Product
The term “Like-Substance Product” shall mean a Generic Product or Biosimilar Product.

1.96 Limited Field

The term “Limited Field” shall mean [* * *].

1.97 MAA
The term “MAA” shall mean a marketing authorization application, including all necessary documents, data, and other information concerning a Product, required for Regulatory Approval of the Product as a pharmaceutical product by the EMA or an equivalent application (such as an NDA) to the equivalent agency in any other country or group of countries (e.g. an NDA with the FDA).

1.98 Major Markets
The term “Major Markets” shall mean the [* * *].

1.99 Marketing Study
The term “Marketing Study” shall mean any human clinical study for a Shared Product conducted following Initiation of a Pivotal Study for such Shared Product that is not required for receipt of Regulatory Approval (whether such human clinical study is conducted prior to or after receipt of such Regulatory Approval) and is not a Post-Approval Commitment Study, but that may be useful in support of the post-Regulatory Approval exploitation of such Shared Product.

1.100Materials
The term “Materials” shall mean any laboratory research materials that consist of the following substances (other than oligonucleotides): (i) organic or inorganic chemical or compound; (ii) gene; (iii) vector or construct, whether plasmid, phage, virus or any other type; (iv) host organism, including bacteria and eukaryotic cells; (v) eukaryotic or prokaryotic cell line or expression system; (vi) protein, including any peptide or amino acid sequence, enzyme, antibody or protein conferring targeting properties and any fragment of a protein or peptide or enzyme; (vii) genetic material, including any genetic control element (e.g., promoters); (viii) virus; or (ix) assay.

1.101Manufacture
The term “Manufacture” or “Manufacturing” shall mean all operations in the manufacture, receipt, incoming inspections, storage and handling of materials, manufacture, processing, formulation, filling, packaging, labeling, warehousing, quality control testing (including in-process release and stability testing), shipping and release of Shared Products.

1.102Medical Affairs Activities
The term “Medical Affairs Activities” shall mean the coordination of medical information requests and field based medical scientific liaisons with respect to Co-Promotion Products, including activities of medical scientific liaisons, activities involving key opinion leaders, and the provision of medical information services with respect to a Co-Promotion Product.

1.103Method of Use Claim
The term "Method of Use Claim" shall mean, for a given Product in a given country of the Territory, a Valid Claim of an issued patent that claims an approved indication in such country for the Product.

1.104Net Sales
[* * *].

1.105Non-Compound Active Agent
The term “Non-Compound Active Agent” shall mean a therapeutically or prophylactically active ingredient or compound that is not a Compound.

1.106Not Available Target
The term “Not Available Target” shall mean, [* * *].

1.107Party
The term “Party” shall mean Dicerna or Roche, as the case may be, and “Parties” shall mean Dicerna and Roche collectively.

1.108Patent Rights
The term “Patent Rights” shall mean all rights under any issued patent or pending patent application (which, for the purposes of this Agreement, includes certificates of invention, applications for certification of invention, and priority rights), in any country of the Territory, including any patents issuing on such patent application, and further including any and all provisional, substitution, extension (including pediatric exclusivity extension) or supplementary protection certificate, reissue, reexamination, restoration, renewal, confirmation, registration, revalidation, revisions and additions, divisional, continuation, continued prosecution (and requests therefor), or continuation-in-part of any of the foregoing.

1.109Pharmacovigilance Agreement
The term “Pharmacovigilance Agreement” shall mean an agreement entered into by the Parties to set forth the responsibilities and obligations of the Parties with respect to the procedures and timeframes for compliance with Applicable Laws pertaining to safety of the applicable Product and its related activities.

1.110Phase I Study
The term “Phase I Study” shall mean a human clinical trial in any country that would satisfy the requirements of 21 C.F.R. § 312.21(a) (FDCA), as amended from time to time, and the foreign equivalent thereof.

1.111Phase II Study
The term “Phase II Study” shall mean a human clinical trial, for which the primary endpoints include a determination of an effective dose range for Phase III Studies and/or a preliminary determination of efficacy in patients being studied as described in 21 C.F.R. § 312.21(b) (FDCA), as amended from time to time, and the foreign equivalent thereof.

1.112Phase III Study
The term “Phase III Study” shall mean a human clinical trial that is prospectively designed to demonstrate statistically whether a product is safe and effective for use in humans in a manner sufficient to obtain Regulatory Approval to market such product in patients having the disease or condition being studied as described in 21 C.F.R. § 312.21(c) (FDCA), as amended from time to time, and the foreign equivalent thereof.

1.113Phase IV Study
The term “Phase IV Study” shall mean a human clinical trial initiated post-approval of the Product to accumulate evidence about the efficacy and/or safety of the Product, which shall not include any Post-Approval Commitment Study.

1.114Pivotal Study

The term “Pivotal Study” shall mean, with respect to any Product, a Clinical Study that at the time of Initiation (or any later expansion of patient enrollment, if applicable), is expected to be the basis for Regulatory Approval of such Product.

1.115PN Field Restriction
The term “PN Field Restriction” shall mean, [* * *].

1.116Post-Approval Commitment Study
The term “Post-Approval Commitment Study” shall mean any human clinical study for a Shared Product conducted after marketing authorization of such Shared Product has been obtained from the FDA at the request of or requirement of the FDA.

1.117Product
The term “Product” shall mean any Licensed Product or Roche Product.

1.118Product Labeling or Product Label
The term “Product Labeling” or “Product Label” shall mean, with respect to a Product in a country in the Territory, (a) the Regulatory Authority-approved prescribing information for such Product for such country, including any required patient information, and (b) all labels and other written, printed or graphic matter upon a container, wrapper or any package insert utilized with or for such Product in such country, including any required patent marking.

1.119R&D Collaboration Term
The term “R&D Collaboration Term” shall mean the period of time commencing on the first individual Target Term and ending on the conclusion of the last individual Target Term.

1.120Regulatory Approval
The term “Regulatory Approval” shall mean any approvals (including supplements, amendments, pre- and post-approvals, pricing and reimbursement approvals), licenses, registrations or authorizations (including marketing and labeling authorizations) by a Regulatory Authority, necessary for the research, Development, registration, Manufacture (including formulation), distribution, importation, exportation, use, sale or Commercialization of a pharmaceutical product (including a Compound or Product) in a regulatory jurisdiction in the Territory.

1.121Regulatory Authority
The term “Regulatory Authority” shall mean any national, supranational (e.g., the European Commission, the Council of the European Union, the EMA), regional, state or local regulatory agency, department, bureau, commission, council or other governmental entity including the FDA or any counterpart of the FDA outside the United States, in each country involved in the granting of regulatory approval for, or with authority over, the research, Development, registration, Manufacture (including formulation) and Commercialization of, a pharmaceutical product (including a Compound or Product), which may include the authority to grant the required reimbursement and pricing approvals for such sale.

1.122Regulatory Exclusivity
The term “Regulatory Exclusivity” shall mean any exclusive marketing rights or data exclusivity rights conferred by any governmental authority under Applicable Law with respect to a Product in a country or jurisdiction in the Territory to prevent Third Parties from selling such Product in such country or jurisdiction, other than a Patent Right, including orphan drug exclusivity, pediatric exclusivity, rights

conferred in the U.S. under the FD&C Act, in the EU under Directive 2001/83/EC, or rights similar thereto in other countries or regulatory jurisdictions in the Territory.

1.123Regulatory Expenses
The term “Regulatory Expenses” shall mean those FTE Costs and any direct out-of-pocket costs (including filing, user, maintenance and other fees paid to Regulatory Authorities) paid or incurred as an expense in accordance with Accounting Standards by Roche or any of its Affiliates or Sublicensees after the Effective Date, that are specifically identifiable or reasonably allocable to the preparation of regulatory submissions for, and the obtaining and maintenance of Regulatory Approval, including compliance with Regulatory Approvals and requirements of such Regulatory Authorities, adverse event recordation and reporting and regulatory affairs activities.

1.124Regulatory Materials
The term “Regulatory Materials” shall mean any regulatory application, submission, notification, communication, correspondence, registration and other filings made to, received from or otherwise conducted with a Regulatory Authority in order to Develop or Commercialize the applicable Lead Compound and Lead Product. Regulatory Materials include any CTAs.

1.125Research Plan
The term “Research Plan” shall mean the agreed upon plan of research for each Selected Target including the criteria to be used for selecting a Clinical Candidate. Updates to the Research Plan do not require an amendment to this Agreement and may be approved by unanimous consent of the JRC.

1.126Reserved Target
The term “Reserved Target” shall mean [* * *]. The number of Host Cell Factor Targets designated as either Reserved Targets, Selected Targets and Discontinued Targets at any given time cannot exceed five (5) in aggregate during the course of the collaboration (the “**Host Cell Factor Target Limitation**”).

1.127 Roche Background Improvements
The term “Roche Background Improvements” shall mean [* * *].

1.128Roche Compound
The term “Roche Compound” shall mean an oligonucleotide compound Controlled by Roche and provided by Roche or its Affiliates into the R&D Collaboration that is Directed To a Selected Target and is not a GalXC Molecule.

1.129Roche Grant-Back Patent Rights
The term “Roche Grant-Back Patent Rights” shall mean Patent Rights Controlled by Roche that are reasonably necessary to develop, have developed, manufacture, have manufactured, use, offer to sell, sell, promote, export and import Dicerna Compounds or Licensed Products that are not Combination Products. For purposes of clarity, Genentech Patent Rights are specifically excluded from Roche Grant-Back Patent Rights.

1.130Roche Group
The term “Roche Group” shall mean collectively Roche, its Affiliates and its Sublicensees.

1.131Roche Patent Rights
The term “Roche Patent Rights” shall mean all Patent Rights that Roche Controls (other than by a license from Dicerna under this Agreement) during the Agreement Term other than Licensed IP and

Joint Patent Rights. For purposes of clarity, Genentech Patent Rights are specifically excluded from Roche Patent Rights.

1.132Roche Product
The term “Roche Product” shall mean any product, including any Combination Product, containing a Roche Compound as a pharmaceutically active ingredient, regardless of their finished forms or formulations or dosages. One Roche Product may be distinguished from another Roche Product by the Roche Compound being a distinctive active pharmaceutical ingredient.

1.133Royalty Term
The term “Royalty Term” shall mean, with respect to a Product and for a given country, the period of time commencing on the date of First Commercial Sale of the Product in such country and ending:

(a) for Lead Products: on the later of the date that is [* * *].

(b) for Hybrid Products: on the later of the date that is [* * *] and

(c) for Selected Target Products: on the later of the date that is [* * *]

1.134Sales
The term “Sales” shall mean, for a Product in a particular period, the sum of (i) and (ii):

[* * *].

By way of example, the gross-to-net deductions taken in accordance with IFRS as of the Effective Date include:

(a) credits, reserves or allowances actually granted for (i) damaged, outdated, returned, rejected, withdrawn or recalled Product, (ii) wastage replacement and short-shipments; (iii) billing errors and (iv) indigent patient and similar programs (*e.g.*, price capitation);

(b) governmental price reductions and government mandated rebates;

(c) chargebacks, including those actually granted to wholesalers, buying groups and retailers;

(d) customer rebates, including cash sales incentives for prompt payment, cash and volume discounts; and

(e) taxes and any other governmental charges or levies imposed upon or measured by the import, export, use, manufacture or sale of a Product (excluding income or franchise taxes).

For purposes of clarity, any such Sublicensee sales as reported to Roche in accordance with Compulsory Sublicense agreements shall be excluded from the sales amount.

When a Product is a Combination Product, and there are deductions under clauses (a)-(e), such deductions shall be allocated to such Combination Product as agreed or determined under Section 11.4.4. For purposes of clarity, sales by Roche and its Affiliates to any Sublicensee that is not a Roche Affiliate for resale shall be excluded from “Sales” under this clause (i).

(i) for Sublicensees that are not Affiliates of Roche (and excluding Compulsory Sublicensees), the sales amounts reported to Roche and its Affiliates in accordance with their then-currently used accounting standards and Section 2.4. For the purpose of clarity, any such Sublicensee sales as

reported to Roche in accordance with Compulsory Sublicense agreements shall be excluded from the Sales amount, and instead shall be addressed in accordance with Section 11.4.8.

1.135Sales Representative
The term “Sales Representative” shall mean a pharmaceutical sales representative or other persons engaged or employed by either Party to conduct Detailing and other promotional efforts or relevant activities with respect to the Products and consistent with the Commercialization Plan.

1.136Selected Target
The term “Selected Target” shall mean [* * *].

1.137Selected Target Compound
The term “Selected Target Compound” shall mean a Compound that is Directed To a Selected Target but is not the Lead Compound.

1.138Selected Target Product
The term “Selected Target Product” shall mean any Product that (i) includes a Selected Target Compound and (ii) if it includes the Lead Compound, is not a Hybrid Product.

1.139Specific Patent Right
The term “Specific Patent Right” shall mean any Licensed IP Patent Right (other than Dicerna GalXC Platform Patent Rights) exclusively directed to one or more Compound(s) or Licensed Product(s).

1.140Signature Date
The term “Signature Date” shall mean the date set forth on the cover page to this Agreement.

1.141Sublicensee
The term “Sublicensee” shall mean a Third Party to which Roche has licensed rights (through one or multiple tiers), other than through a Compulsory Sublicense, pursuant to this Agreement.

1.142Target Nomination Deadline
The term “Target Nomination Deadline” shall mean the earlier of [* * *] after Roche’s receipt of the following data from the Dicerna Phase I Study:

1. [* * *] and
2. all available patient data from [* * *], and
    (i) [* * *]
    (ii) [* * *]

In the event of either 2.(i) or 2.(ii) above, Roche will inform Dicerna in writing (which may be via email) prior to what would have otherwise been the applicable Target Nomination Deadline.

1.143Target Term
The term “Target Term” shall mean, for a given Selected Target, the period commencing on the date the JRC approves the corresponding Research Plan and ending on the earlier of (a) [* * *] thereafter and (b) the date on which a Clinical Candidate for such Selected Target is selected by the JRC. The Target Term may be (i) extended by Roche for up to [* * *] extensions upon written notice to Dicerna prior to the expiration of the initial [* * *] period, provided that no Compound Directed To such Selected

Target meets the criteria for Clinical Candidate selection as set forth in the applicable Research Plan, or (ii) shortened (or lengthened beyond Roche's unilateral [* * *] extension right) by unanimous decision of the JRC.

1.144Territory
The term "Territory" shall mean all countries of the world.

1.145Third Party
The term "Third Party" shall mean a person or entity other than (i) Dicerna or any of its Affiliates or (ii) a member of the Roche Group.

1.146Transfer Activities
The term "Transfer Activities" shall mean the transfer from Dicerna to Roche of the data, Materials, Know-How (including the GalXC Platform), documentation and other items in Dicerna's possession (including through its Affiliates), and reasonable technical assistance, in each case, to the extent reasonably necessary or useful for Roche to continue Development of the Transfer Compounds, along with such other commercially reasonable actions which may be conducted by Dicerna to effectuate transfer of responsibilities and use good faith efforts to make relevant assignments (to the extent Dicerna has the right to do so) related to the Transfer Compounds, for example, with Regulatory Authorities, patent offices, Third Party contract manufacturing organizations (each a "**CMO**"), Third Party contract research organizations (each a "**CRO**") and Clinical Study investigators. Transfer Activities are to be made at the appropriate time on or after the Effective Date with respect to the Lead Transfer Compounds ("**Lead Transfer Activities**") and Selected Target Transfer Compounds ("**Selected Target Transfer Activities**") and shall be made (i) as set forth in this Agreement, (ii) in accordance with the applicable Transfer Plans or (iii) as otherwise reasonably requested by Roche.

1.147Transfer Compound
The term "Transfer Compound" shall mean: (i) the Lead Compound with respect to the Dicerna Phase I Study and any existing derivative, modification or backup compound to the Lead Compound (each a "**Lead Transfer Compound**"); and (ii) at the point of a Clinical Candidate selection, all Additional Dicerna Compounds that are Directed To the Selected Target associated with such Clinical Candidate selected (each a "**Selected Target Transfer Compound**").

1.148Transfer Plan
The term "Transfer Plan" shall mean (i) a plan for the Lead Transfer Activities ("**Lead Transfer Plan**") or (ii) on a Selected Target-by-Selected Target basis, a plan for the Selected Target Transfer Activities ("**Selected Target Transfer Plan**"). Each Transfer Plan may consist of multiple sections applicable for relevant functions (e.g. regulatory, clinical, safety, manufacturing, clinical). The JRC will establish, implement and oversee the Parties' activities under each Transfer Plan. The initial Lead Transfer Plan has been provided by Dicerna by letter dated October 30, 2019.

1.149US
The term "US" shall mean the United States of America and its territories and possessions.

1.150US$
The term "US$" shall mean US dollars.

1.151Valid Claim

The term “Valid Claim” shall mean, as applicable, a claim in any: (i) unexpired and issued patent within the applicable Patent Rights in any country of the Territory that has not been disclaimed, revoked or held invalid by a final nonappealable decision of a court of competent jurisdiction or government agency or (ii) pending patent application within the applicable Patent Rights in any country of the Territory that has been on file with the applicable patent office for no more than [* * *].

1.152Viral Target
The term “Viral Target” shall mean [* * *].

1.153Additional Definitions
Each of the following definitions is set forth in the Section of this Agreement indicated below:

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Bankruptcy Code	21
Breaching Party	20.2.1
CDA	22.11
Chairperson	7.3
Chemical Raw Materials	8.4.1
Chugai	1.3
CMO	1.146
Compulsory Profit Share Percentage	11.4.8
Compulsory Sublicense	1.141
Compulsory Sublicensee	1.141
Co-Promote, Co-Promoting, Co-Promotion	10.6.4
Co-Promotion Agreement	10.6.3
Co-Promotion Option	10.6.1
Co-Promotion Right	10.6.1
Cost Share Option	6.3
Cost Share Package	6.3.1.1
Cost Share Right	6.3
CRO	1.146
Debarred	22.6
Decision Period	15.6.2
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Defending Party	15.7
Dicerna	cover page
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Dicerna Invention	1.85
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Definition	Section
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DOJ	22.4
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FTC	22.4
Full Review	3.7(a)(iii)3.7(a)(iii)
HSR Act	22.4
H-W Suit Notice	15.8
IND	1.36
Indemnified Party	17.3
Indemnifying Party	17.3
Initial Cost Share Payment	6.3.2(a)
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Joint Invention	1.85
JOT Co-Leader	7.11
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Non-Exclusive Roche License	2.3
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Pre-Reserved Target	3.7
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Receiving Party	1.28

Definition	Section
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Relative Commercial Value	11.4.4
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Roche Estimate	10.6.2(a)
Roche Indemnitees	17.2
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Selected Target Transfer Compound	1.147
Selected Target Transfer Plan	1.148
Sensitive Information	20.2.3
Settlement	15.6
Shared Product	6.3.1.2
Shared Product Questions	(a)10.6.2(a)
SPCs	15.9
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Target Nomination	3.2
VAT	13.5

2. Grant of License

2.1 Research Cross License

Subject to the terms and conditions of this Agreement, each Party grants to the other Party during the R&D Collaboration Term a non-exclusive right and license under Know-How and Patent Rights Controlled by such Party solely to enable the other Party to perform its activities contemplated under the Research Plan under this Agreement for each Selected Target.

2.2 Commercial License

(a) Subject to the terms and conditions of this Agreement (including Section 2.2(b)), Dicerna hereby grants to Roche: (x) an exclusive (even as to Dicerna) right and license under Dicerna's interest in the Licensed IP, to research, have researched, develop, have developed, register, have registered, make, have made, use, have used, register, have registered, sell, have sold, offer for sale, import, have imported, export and have exported, the below Compounds, Products and Companion Diagnostics which are solely with respect thereto in the Field (subject to (ii) below) in the Territory; and (y) non-exclusive right and license under Dicerna's interest in the Licensed IP, to research, have researched, develop, have developed, register, have registered, make, have made, use, have used, register, have registered, sell, have sold, offer for sale, import, have imported, export and have exported, the below Companion Diagnostics (other

than solely with respect to the below Compounds and Products) in the Field (subject to (ii) below) in the Territory.

(i) If the Compound, Product or Companion Diagnostic is Directed To a Viral Target, then such license granted by Dicerna to Roche will be in the Field with respect to such Compound, Product or Companion Diagnostic.

(ii) If the Compound, Product or Companion Diagnostic is Directed To a Host Cell Factor Target, then for so long as such Host Cell Factor Target is encumbered by rights granted to the Ex-Limited Licensee, such license granted by Dicerna to Roche will be in the Limited Field with respect to such Compound, Product or Companion Diagnostic. If at any time the Ex-Limited Licensee restrictions that keep Roche limited to such a Limited Field license no longer apply, then as of such time Dicerna hereby grants to Roche the full license under Section 2.2(a)(i) and Dicerna shall promptly notify Roche pursuant to Section 3.7(c)(ii).

(b) The exclusivity of the above licenses is subject to the right of Dicerna and its respective Affiliates to Complete the Dicerna Phase I Study, conduct its activities under the Research Plans and perform its Co-Promotion Right obligations (if any) for the Co-Promotion Products in the US, to the extent expressly contemplated by this Agreement.

2.3 Non-Exclusive Roche License

In the event of a Non-Exclusive Trigger under Section 20.3.1, and with respect to a given Roche Compound, Roche Product or Companion Diagnostic relevant to such termination (either for Agreement termination as a whole or with respect to a given Selected Target for Selected Target termination), the non-exclusive license grant under Section 2.2(a)(y) shall continue as is and the exclusive license grant under Section 2.2(a)(x) shall continue as a non-exclusive license grant (collectively, the "**Non-Exclusive Roche License**").

2.4 Sublicenses

2.4.1 Right to Sublicense to its Affiliates

Roche shall have the right to grant sublicenses to its Affiliates (through multiple tiers), and to Chugai if Chugai is not an Affiliate under this Agreement, under its rights granted under Sections 2.1, 2.2 and 2.3 without prior approval of Dicerna. If Roche grants a sublicense permitted under this Section 2.4.1, Roche shall ensure that all of the applicable terms and conditions of this Agreement shall apply to the Affiliate (and Chugai as applicable) to the same extent as they apply to Roche for all purposes. Roche assumes full responsibility for the performance of all obligations and observance of all terms so imposed on such Affiliate (and Chugai as applicable) and shall itself account to Roche for all payments due under this Agreement by reason of such sublicense.

2.4.2 Right to Sublicense to Third Parties

Subject to the terms of this Agreement, Roche and its Affiliates shall have the right to grant written sublicenses to Third Parties (through multiple tiers) under its rights granted under Sections 2.2(a) and 2.3 without prior approval of Dicerna, *with the proviso* [* * *]. Roche shall inform Dicerna promptly after the signature of aa sublicense agreement under this Section 2.4.2 and provide a copy of each such agreement with a Third Party to Dicerna within [* * *] after execution thereof, which sublicense may be redacted to omit any terms not necessary to confirm Roche's compliance with this Section 2.4.2. If Roche grants a sublicense permitted under this Section 2.4.2, Roche shall ensure that all of the applicable terms and conditions of this Agreement shall apply to the Sublicensee to the same extent as they apply to Roche for all purposes. Roche assumes full responsibility for the performance of all

obligations and observance of all terms so imposed on such Sublicensee and shall itself account to Dicerna for all payments due under this Agreement by reason of such sublicense.

For clarity, without Dicerna's prior written consent, Roche may not sublicense to non-Affiliate entities (i) its rights granted under Section 2.1 and (ii) its rights and obligations to conduct its activities under the R&D Collaboration.

2.4.3 Right to Subcontract

Both Parties shall have the right to subcontract the work performed under this Agreement (subject, in the case of Dicerna, to Section 10.6.4) without prior approval of the other Party, provided that (a) each Party will remain responsible for the work allocated to subcontractors to the same extent as if it had done such work itself, and (b) each Party's applicable subcontracts shall be consistent with its obligations to the other Party under this Agreement and to the extent applicable fulfill such Party's obligation to the other Party to comply with obligations of confidentiality and non-use regarding Confidential Information and to assign such Inventions required by this Agreement to be assigned to the other Party.

2.5 License Limitation

In consideration of the limitations of the Roche exclusivity covenant in Section 3.9(b)(b), Roche agrees that during the R&D Collaboration Term, the scope of the license rights (other than the Lead Compound) granted under Sections 2.1, 2.2, 2.3, and 2.4 to Roche are limited to [* * *].

2.6 Freedom-to-operate Licenses

2.6.1 Know-How

Roche hereby grants to Dicerna an irrevocable non-exclusive, worldwide, royalty-free license, with the right to sublicense, under such Roche Know-How as Roche may provide to Dicerna for use in research, development and commercialization of oligonucleotide compounds. Roche shall have no obligation to transfer or provide any information or materials to Dicerna as a result of this Section 2.6.1 unless otherwise expressly agreed by Roche.

Dicerna hereby grants to Roche an irrevocable non-exclusive, worldwide, royalty-free license, with the right to sublicense, under such Dicerna Know-How as Dicerna may provide to Roche for use in research, development and commercialization of oligonucleotide compounds. Dicerna shall have no obligation to transfer or provide any information or materials to Roche as a result of this Section 2.6.1 unless otherwise expressly agreed by Dicerna.

2.6.2 Mutual Use of Confidential Information

Subject to and without limiting any other license rights or exclusivity granted under this Agreement, Roche (and its Affiliates) and Dicerna (and its Affiliates) will have the right to use any Confidential Information disclosed by the other Party in connection with the R&D Collaboration and retained in the unaided memories of its employees after having access to such Confidential Information (without reference to tangible copies of such information), provided that this right to use does not constitute a license under any Patent Rights. [* * *].

2.6.3 GalXC Platform and Roche Background Patent Licenses

Subject to Section 3.9(b)(b) and the license granted in Section 2.2, Roche hereby grants back to Dicerna a non-exclusive, worldwide, royalty-free license, with the right to sublicense through multiple

tiers, under Patent Rights invented solely by Dicerna during the R&D Collaboration specifically claiming Roche Background Improvements, to research, have researched, develop, have developed, register, have registered, make, have made, use, have used, register, have registered, sell, have sold, offer for sale, import, have imported, export and have exported products.

Subject to Section 3.9(a)(a), Dicerna hereby grants back to Roche a non-exclusive, worldwide, royalty-free license, with the right to sublicense through multiple tiers, under Patent Rights invented solely by Roche during the R&D Collaboration specifically claiming GalXC Platform Improvements, to research, have researched, develop, have developed, register, have registered, make, have made, use, have used, register, have registered, sell, have sold, offer for sale, import, have imported, export and have exported products.

3. R&D Collaboration

3.1 Initiation

At any time after the Effective Date but in no case later than the Target Nomination Deadline, Roche will either

(i) submit to Dicerna in writing the names of the [* * *] that Roche wants to nominate as the initial Selected Targets under the process described under Section 3.2,

(ii) provide written notice to Dicerna that Roche elects not to initiate the R&D Collaboration, or

(iii) provide written notice to Dicerna of termination of the Agreement without cause pursuant to Section 20.2.4.

In the event of either clause (ii) or (iii) above, the R&D Collaboration will not commence, the remainder of this Article 3 and all references to the R&D Collaboration in this Agreement will not apply, and Roche will receive no rights or licenses under Selected Target Products.

3.2 Selected Target Nomination

Roche may nominate prior to the Target Nomination Deadline [* * *] initial Selected Targets (or up to five (5) total Selected Targets as permitted under this Agreement) by utilizing the Gatekeeper Process designated as "**Target Nomination**", with up to [* * *] of the Selected Targets being Host Cell Factor Targets. Roche may replace up to [* * *] of the Selected Targets with a Reserved Target once utilizing the replacement processes described in Section 3.6, where up to [* * *] of the Reserved Targets may be Host Cell Factor Targets.

3.3 Scope

During the R&D Collaboration Term, Roche and Dicerna shall conduct a mutually agreed discovery, research and pre-clinical development collaboration (prior to Development) for HBV disease therapies (the "**R&D Collaboration**") with the goal of advancing lead candidates from each of Dicerna's and Roche's proprietary technology platforms Directed To the Selected Targets from which one or more Additional Dicerna Compounds and/or Roche Compounds may be generated and advanced into Development and eventually translated into Products for Commercialization by Roche. The activities conducted in connection with the R&D Collaboration will be pursuant to individual Research Plans and will be overseen by the JRC. The Parties shall not work on more than [* * *] Selected Target Research Plans at a given time without the written agreement of both Parties (which may include approved JRC minutes). For avoidance of doubt, if the Parties (or JRC) agree to suspend activities on a given Selected Target Research Plan, it shall not count as one of such [* * *].

3.4 Research Plans

Each Research Plan will outline the program and the work by the Parties to discover, research and pre-clinically develop (prior to Development) Additional Dicerna Compounds and Roche Compounds Directed To the applicable Selected Target up to the point of Clinical Candidate selection, as such plans may be updated from time to time as provided in this Agreement. Each Research Plan shall also include the plans for Roche at its own expense to either initiate or further pre-clinically develop (prior to Development) existing Roche Compounds Directed To the applicable Selected Target. Unless decided otherwise by the JRC, the Research Plan for each Selected Target will be updated annually by the JRC. Any changes shall be reflected in written amendments to the Research Plans approved by the JRC. Each Research Plan will set forth: (i) the scope of the R&D Collaboration for the applicable Selected Target broken down by activities for Dicerna Compounds and Roche Compounds, as applicable, and the resources that each Party will dedicate to the activities contemplated within the scope of the R&D Collaboration for such Dicerna Compounds and Roche Compounds, respectively; and (ii) specific objectives for each year, which objectives will be updated or amended, as appropriate, by the JRC as research progresses and based on the applicable criteria for selection of a Clinical Candidate. While each of the Dicerna and Roche teams shall primarily focus on the further research of compounds derived from their respective proprietary platforms, certain activities leveraging unique capabilities and expertise of a given Party may be applied to the Compounds generated by the other Party.

3.5 Information Exchange

3.5.1 Progress Reports

It is expected that the Research Plans shall be conducted as a joint team under the supervision of the JRC. Unless otherwise stated in the applicable Research Plan, each Party will only share data, information, results and output from in vitro and in vivo studies prior to the time a Compound is selected by the JRC to progress to non-human primate studies. After such time , Dicerna shall provide Roche with the chemistry and sequence information on the GalXC Molecule. Unless the JRC determines otherwise, on at least a Calendar Quarter basis during the R&D Collaboration Term, each Party shall prepare and provide to the JRC a detailed written report consistent with each Party's internal practices summarizing the progress of the work performed by each Party in the course of the R&D Collaboration during the preceding Calendar Quarter, and each Party will provide a final report to the JRC at the end of a given Research Plan with respect to its activities under the Research Plan.

3.5.2 Research Records

Each Party shall maintain records of the R&D Collaboration (or cause such records to be maintained) consistent with such Party's internal practices that each Party determines in good faith records in sufficient detail and in good scientific manner the work done and results achieved by or on behalf of such Party in the performance of the R&D Collaboration. All laboratory notebooks shall be maintained for no less than is reasonably necessary to comply with Applicable Law or the term of any Patent Rights issuing therefrom.

3.6 Replacement and Reserved Targets

Roche may only replace Selected Targets with a Reserved Target no more than [* * *] times during the R&D Collaboration Term, as provided in this Section 3.6 and in Section 3.7 below. During the Target Term for a Selected Target, if no Compounds Directed To such Selected Target are generated that meet the criteria for Clinical Candidate selection by the JRC as set forth in the applicable Research

Plan for such Selected Target and Roche requests in writing to replace such Selected Target with a Reserved Target, then such Reserved Target shall be deemed a Selected Target in place of such prior Selected Target (and no longer a Reserved Target) and the JRC shall develop a Research Plan for such replacement Selected Target no later than [* * *] after Roche's written request for replacement.

3.7 Gatekeeper Process

From the Effective Date until the end of the Target Nomination Deadline or last Target Term, whichever is later, Dicerna will keep Roche informed of the identity and contact information for the Gatekeeper. The Parties agree the initial Gatekeeper will [* * *]. The Parties will enter into a customary confidentiality agreement that includes confidentiality at least as stringent as the provisions set forth in Article 19 and prohibits the Gatekeeper from disclosing to Roche the Not Available Targets or from disclosing to either Dicerna or Roche the identity of a target that was the subject of inquiry by the other Party.

At the Effective Date, the Gatekeeper will have a list of Not Available Targets and from time to time thereafter (including at least [* * *] per Calendar Quarter, including in response to inquiries hereunder), Dicerna will provide the Gatekeeper with an update to the list of Not Available Targets, together with any applicable rights Dicerna can still grant hereunder with respect to such Not Available Targets, and any associated restrictions.

At the Effective Date, the Gatekeeper has confirmed [* * *] Host Cell Factor Target as a Reserved Target by letter dated October 28, 2019 ("**Pre-Reserved Target**"). Notwithstanding anything in this Agreement, including the right to select [* * *] initial Selected Targets under Section 3.2 such Pre-Reserved Target shall remain a Reserved Target until such time as Roche in its discretion nominates it as a Selected Target.

The following are the Gatekeeper Processes to be followed with respect to target nomination (for Selected Targets) or for target nomination (for Reserved Targets), subject to the restrictions in Sections 1.136 and 1.127.

(a) [* * *].

(b) [* * *].

(c) [* * *].

(d) [* * *].

3.8 Compound Progression

Subject to JRC decisions to the contrary, Research Plan activities for each Selected Target shall continue until the selection of a Clinical Candidate from the overall pool of Roche Compounds and Additional Dicerna Compounds on a Selected Target-by-Selected Target basis. The periodic review by the JRC of the results of the Research Plans will inform which Compounds to further advance and whether to terminate development of certain Compounds and/or a Selected Target through appropriate amendments to the Research Plans. The JRC shall decide which Compound(s) will be advanced into Development to be conducted and funded by Roche with all remaining Compounds Directed To such Selected Target being reserved by Roche as backup Compounds and included within the licenses granted to Roche under Section 2.2.

During the Target Term, the JRC will make plans for the eventual Selected Target Transfer Activities with respect to Additional Dicerna Compounds (and if applicable, Roche Compounds) to Roche to enable Roche to timely continue advancement of Additional Dicerna Compounds, which Selected Target Transfer Activities will be conducted pursuant to a Selected Target Transfer Plan approved by the JSC and as otherwise reasonably requested by Roche. Selected Target Transfer Activities set forth in the given Selected Target Transfer Plan will be provided by or on behalf of Dicerna free of charge. For additional Selected Target Transfer Activities reasonably requested by Roche not set forth in the given Selected Target Transfer Plan, Dicerna shall provide up to [* * *] free of charge. Thereafter, additional hours will be provided at Roche's expense based on Dicerna's then current FTE Rate and Roche will reimburse Dicerna for all of Dicerna's reasonable out of pocket expenses incurred in connection therewith.

If the JRC fails to select a Clinical Candidate for a given Selected Target prior to the expiration of the Target Term, Roche will either terminate its rights to Licensed Products under Section 20.2.5 (and such Selected Target will become a Discontinued Target) or will notify Dicerna of its intention ("**Roche Continuation Notice**") to proceed with the further research and development of Licensed Products for such Selected Target in which case the JRC will promptly implement the associated Selected Target Transfer Plan. If Roche has provided a Roche Continuation Notice and fails to progress a Clinical Candidate Directed To such Selected Target within [* * *], then Roche must terminate such Selected Target under Section 20.2.5 (and such Selected Target will become a Discontinued Target).

3.9 Exclusivity

During the Exclusivity Period:

(a) Dicerna will collaborate exclusively with Roche in the discovery, research, and development of GalXC Molecules Directed To Selected Targets in the Limited Field or if cleared pursuant to Section 3.7 the Field during the R&D Collaboration, other than as may be incidental to research activities outside the scope of this Agreement.

(b) [* * *].

3.10 Research Plan Costs of Performance

Except as otherwise expressly set forth in this Agreement, in the applicable Research Plan or as otherwise agreed by the Parties in writing, each Party shall bear its expenses conducting R&D Collaboration activities for a Selected Target during the applicable Target Term as set forth in the applicable Research Plan.

4. Diligence

Roche and Dicerna shall use Commercially Reasonable Efforts to perform their respective activities and fulfil their respective obligations contemplated by this Agreement or as may be agreed upon in any subsequent written agreements with respect to the subject matter hereof. Examples of the foregoing include:

(a) Dicerna shall use Commercially Reasonable Efforts to Complete the Dicerna Phase I Study and to conduct the Lead Transfer Activities in accordance with the Lead Transfer Plan (including any timelines therein);

(b) Roche shall use Commercially Reasonable Efforts to Develop and Commercialize at least one (1) Lead Product in the Territory;

(c) on a Selected Target-by-Selected Target basis, and subject to the JRC deciding to stop work on a particular class of compounds for a given Selected Target, both Roche and Dicerna shall use Commercially Reasonable Efforts to (i) discover, research and pre-clinically develop (prior to Development) at least one (1) Roche Compound and Additional Dicerna Compound, respectively, as a Clinical Candidate, and (ii) perform their respective obligations under the applicable Research Plan; and

(d) on a Selected Target-by-Selected Target basis, after the first Clinical Candidate selection, Roche shall use Commercially Reasonable Efforts to Develop and Commercialize at least one Selected Target Product or Hybrid Product. Roche's efforts to Develop and Commercialize a Selected Target Product that includes a Lead Compound or Hybrid Product shall satisfy the obligations of subsection (b) above if at any time after the Completion of a Phase II Study for the Lead Product Roche in its good faith belief determines that continued Development and Commercialization of Product containing the Lead Compound as either the sole active agent (or in combination only with an active agent other than a Compound) is scientifically or medically unviable (or commercially unviable after First Commercial Sale of a Selected Target Product that includes a Lead Compound or Hybrid Product).

5. Lead Transfer Activities

Lead Transfer Activities set forth in the Lead Transfer Plan will be provided by or on behalf of Dicerna free of charge. For all other Lead Transfer Activities reasonably requested by Roche not set forth in the Lead Transfer Plan, Dicerna shall provide up to [* * *] free of charge. Thereafter, additional hours for such Lead Transfer Activities not set forth in the Lead Transfer Plan will be provided at Roche's expense based on Dicerna's then current FTE Rate and Roche will reimburse Dicerna for all of Dicerna's reasonable out of pocket expenses incurred in connection therewith.

6. Development

6.1 Development of Lead Product by Dicerna through Dicerna Phase I Study

Dicerna shall, at its sole cost (other than the Optional Phase I Cohorts(s), if applicable), be responsible for Completion of the Dicerna Phase I Study, including, upon notification to the JRC, reasonable amendments to the existing protocols within the ordinary course of business that are not material deviations other than as required by Regulatory Authorities (with any such material deviation amendments proposed by Dicerna requiring approval of the JRC including via the applicable JOT). Dicerna shall promptly (i) disclose and make available to Roche through the JRC (including via the applicable JOT) the data and information reasonably requested by Roche about the Dicerna Phase I Study while on-going (for each time the data is analyzed, blinded or unblinded for SRC or for any interim analyses), (ii) upon Roche's advance written request (which may be by email), permit Roche to join (in person or by teleconference) as a non-participating observer in meetings between Dicerna and the principal investigators involved in the Dicerna Phase I Study and meetings between Dicerna and the CRO(s) involved in the Dicerna Phase I Study, and (iii) if and to the extent provided in the Lead Transfer Plan, provide Roche with access to data generated in connection with the Dicerna Phase I Study prior to and after Completion, in each case, on or after the Effective Date.

Dicerna shall also be responsible, at its sole cost, for completing all ongoing preclinical or other studies for the Lead Compound. Dicerna shall disclose and make available to Roche through the JRC (or as otherwise requested by Roche) all data and information reasonably requested by Roche about such

preclinical or other studies associated with the Lead Compound while on-going, including any safety review committee output, interim or preliminary results.

As reasonably necessary for Roche to continue Development of the Lead Compound, Dicerna shall conduct the Lead Transfer Activities. As part of the Lead Transfer Activities, Dicerna will cooperate with Roche and disclose and make available to Roche copies of all data and information in Dicerna's possession and Control regarding the Lead Compound and Lead Product which is reasonably necessary for Roche's Development of such Lead Product and in the timelines reasonably requested by Roche or as set forth in the Lead Transfer Plan.

6.1.1 Optional Phase I Cohort(s)

Dicerna will prepare and file a protocol amendment for the Dicerna Phase I Study for optional additional cohort(s) ("**Optional Phase I Cohort(s)**") to explore different doses or dosing regimen. Such protocol amendments or Optional Phase I Cohort(s) may be used for IND Filing. Dicerna will conduct the Optional Phase I Cohort(s) at Roche's expense, however the study design and cost will be mutually agreed by the Parties prior to initiation of the activities, otherwise Roche will have no obligation to fund and Dicerna will have no obligation to conduct the Optional Phase I Cohort(s).

6.2 Development by Roche

Other than Dicerna's development responsibilities listed in Section 6.1, Roche, at its sole cost and discretion (subject to Article 4 and subject to discretion limitations and cost sharing under Dicerna's Cost Share Option), shall be responsible for pursuing Development of Products.

Roche shall maintain records of its Development activities (or cause such records to be maintained) consistent with its internal practices. Roche shall be responsible for the correct use of Dicerna PII/Samples in line with Applicable Law and the informed consent forms. Notwithstanding anything to the contrary in this Agreement but subject to Section 6.1 above (and except with respect to the Lead Compound and Lead Product if Dicerna exercises its Cost Share Option), Dicerna will not bear any costs or expenses in connection with Development of Compounds or Products.

6.3 Dicerna Cost Share Option

Dicerna shall have the option (the "**Cost Share Option**") (unless earlier waived in accordance with this Section) to share in Development Costs and thereby receive increased royalties in the US for the Shared Products as described in this Agreement (the "**Cost Share Right**"). For so long as Dicerna has the Cost Share Option, Roche will provide to Dicerna through the JRC the current Development Plan and any updates and amendments thereto.

6.3.1 Option and Exercise

6.3.1.1 Roche Provision of Cost Share Package

Unless Dicerna earlier waives its Cost Share Option in writing, no later than at such time as Roche formally decides (based on Roche's then current internal governance decision-making process and committees) to proceed into the first Pivotal Study for the Lead Product (or a Hybrid Product, as applicable), Roche shall provide to Dicerna a package ("**Cost Share Package**") including (i) relevant data from the previous Clinical Studies conducted by or on behalf of Roche, if not already shared, (ii) an accounting of Roche's actual Development Costs up to and including the previous Calendar Quarter, (iii) a copy of Roche's then-existing proposed Development Plan for the Lead Product or Hybrid Product and (iv) for informational purposes only, Roche's good faith, non-binding forecast, made in accordance with its regular internal forecasting procedures, of all then planned project

Development Costs consistent with the Development Plan for the Lead Product or Hybrid Product (for clarity, the information that Roche provides to its internal decision-making committee for the purposes of deciding whether to proceed into the first Pivotal Study). Dicerna may ask reasonable questions concerning the contents of the Cost Share Package through the JRC and Roche will make appropriate representatives available to provide answers to Dicerna's questions.

6.3.1.2 Cost Share Option Exercise

Dicerna may exercise its Cost Share Option by providing written notice at any time within [* * *] of Dicerna's receipt of the Cost Share Package. In the event that at the time Roche provides Dicerna with the Cost Share Package, Roche's internal governance decision-making committee has not yet decided to proceed into the first Pivotal Study for the Lead Product, then such exercise by Dicerna shall not be effective unless, within the [* * *] after such exercise, Roche notifies Dicerna that such internal governance committee decision has been made and (a) such decision is consistent with the plan furnished to Dicerna in the Cost Share Package, and (b) Roche notifies Dicerna of any updates or changes to the Cost Share Package, including any deviations from the Development Plan. If such decision is then made by Roche but changes the plan furnished to Dicerna in the Cost Share Package, Roche shall revise the Cost Share Package and deliver it to Dicerna. Dicerna may then exercise its Cost Share Option by providing written notice at any time during the period commencing upon Dicerna's receipt of the revised Cost Share Package and ending thirty (30) days later. Commencing upon Dicerna's exercise of its Cost Share Option and continuing until the end of the Royalty Term unless and until Dicerna fails to meet its obligations under Section 6.3.2, (i) Dicerna shall have the Cost Share Right and (ii) any Lead Product shall also be deemed as a "**Shared Product**". Provided that Dicerna exercises its Cost Share Option for the Lead Product, Dicerna shall also be granted a Cost Share Option for each subsequent Hybrid Product. The foregoing option exercise procedure for the Lead Product shall also be applied for eligible Hybrid Products. Any Hybrid Product for which Dicerna exercises its Cost Share Option shall be deemed a Shared Product.

6.3.2 Payments to Roche

If Dicerna exercises its Cost Share Option, then Dicerna will be responsible for [* * *] as follows:

(a) Dicerna will pay Roche [* * *] of Roche's actual global Development Costs up to and including the last Calendar Quarter prior to Dicerna's exercise of the Cost Share Option (the "**Initial Cost Share Payment**"). Within [* * *] of Dicerna's receipt of an invoice from Roche, Dicerna may notify Roche in writing of its election to set off the Initial Cost Share Payment against the payment from Roche to Dicerna for the Initiation of a Pivotal Study under Section 11.2.1, up to the full amount of the Initial Cost Share Payment. To the extent the Initial Cost Share Payment will not be set off against the Initiation of a Pivotal Study payment under Section 11.2.1, Dicerna will pay Roche such amount within [* * *] of Dicerna's receipt of an invoice from Roche.

(b) For such time as there are forecasted Development Costs, Roche shall in accordance with its regular internal forecasting processes and annual forecast cycle, provide Dicerna its forecast of all then planned project Development Costs for Shared Product(s), including the forecasted budget for a given Calendar Year ("**Annual Budget**") in final form within [* * *]. For such time as there are Shared Product(s), Roche shall (a) within [* * *], give Dicerna preliminary actual Development Costs for such Shared Product(s) for such Calendar Quarter and in the event of material changes, an updated Annual Budget for the remainder of the Calendar Year and (b) within [* * *], give Dicerna the final actual Development Costs for such Shared Product(s) for such Calendar Quarter.

(c) For each Calendar Quarter (including the Calendar Quarter in which Dicerna exercised its Cost Share Option), within [* * *] after Dicerna's receipt of an invoice from Roche, Dicerna will make a payment to Roche for (i) with respect to Lead Products, [* * *] of Roche's actual Development Costs for the applicable previous [* * *] or (ii) with respect to Hybrid Products, [* * *] of Roche's actual Development Costs for the applicable previous [* * *].

(d) In the event that actual Development Costs for a Calendar Year exceed the Annual Budget, including due to Extraordinary Events, by more than [* * *], Dicerna's portion of any such excess Development Costs be deferred and payable to Roche in subsequent Calendar Years, with a maximum amount of such excess payable by Dicerna in a [* * *] not to exceed US dollars [* * *]. For the avoidance of doubt, the maximum amount of Development Costs to be paid by Dicerna after the end of a Calendar Year (but subject to additional deferred payments by Dicerna) shall be [* * *] of Dicerna's portion of the Annual Budget. By way of example, if the Annual Budget for the year 2022 is [* * *] with Dicerna's portion thereof equaling [* * *] and the FDA requires an additional arm be included in a Pivotal Study with the estimated costs for Calendar Year 2022 for such additional arm equaling [* * *] and actual Development Costs incurred by Roche for Calendar Year 2022 (including the additional arm) total [* * *] then Dicerna's total Development Costs payable to Roche shall [* * *] of which [* * *] shall be payable by Dicerna within [* * *] after the end of 2022 and the remaining [* * *] shall be deferred and payable in [* * *] equal installments of [* * *] each after the end of [* * *], respectively.

(e) Invoices submitted by Roche to Dicerna for Development Cost reimbursement will set forth in reasonable detail such costs and expenses to be reimbursed, which costs and expenses shall be specifically identifiable or reasonably allocable to the conduct of Shared Product Development Costs as determined in accordance with the applicable Accounting Standard, including any amounts that may be deferred into the following year.

6.3.3 Adjustment of Royalty Rate for Shared Product US Net Sales

If Dicerna exercises its Cost Share Option and maintains its Cost Share Right by payment of its portion of the Development Costs, then the royalty rate for the Shared Product shall be increased in accordance with Section 11.4.2.1.

6.4 Updates

Roche shall provide an annual written report to Dicerna to update Dicerna with a summary based on information Roche provides to its internal management as to Development progress for each Licensed Product, including all preclinical and clinical development activities. Roche will provide notice and further information regarding changes to such annual reports with respect to such Licensed Products through the JSC (as applicable) in accordance with Section 7.10 and Roche's Alliance Director in accordance with Section 7.12.

7. Governance

7.1 Joint Research Committee

Within [* * *] after the Effective Date, the Parties shall establish a JRC to perform the functions described herein, including

(i) monitor the Dicerna Phase I Study until Completion (which may be conducted by a JOT established by the Parties on behalf of the JRC prior to the first meeting of the JRC),
(ii) develop, approve and update each Research Plan for each Selected Target,
(iii) oversee the R&D Collaboration (upon start of the R&D Collaboration Term),

(iv) establish, revise and implement the Transfer Plans, provided that all updates to the Lead Transfer Plan require Dicerna's written approval or approved JRC minutes, and
(v) share the results of Roche's Development of the Lead Product or Hybrid Product until Dicerna either exercises or fails to exercise its Cost Share Option.

7.2 Joint Steering Committee
Within [* * *] of Dicerna's receipt of the Cost Share Package, the Parties shall establish a JSC. If Dicerna exercises its Cost Share Option, the JSC shall oversee the global Development activities for Shared Products and, if Dicerna exercises its Co-Promotion Option, Co-Promotion activities in the US for Co-Promotion Products. If Dicerna does not exercise its Cost Share Option, the JSC and Roche's Alliance Director shall be primarily responsible for information exchange between the Parties concerning Roche's continued Development and Commercialization of the Lead Product as set forth herein.

7.3 Members
The JRC and JSC shall each be composed of [* * *] persons ("**Members**"). Roche and Dicerna each shall be entitled to appoint [* * *] Members with appropriate seniority and functional expertise. Each Party may replace any of its Members and appoint a person to fill the vacancy arising from each such replacement. A Party that replaces a Member shall notify the other Party at least [* * *] prior to the next scheduled meeting of the applicable Committee. Both Parties shall use reasonable efforts to keep an appropriate level of continuity in representation. Both Parties may invite a reasonable number of additional experts and/or advisors to attend part or the whole Committee meeting with prior notification to the applicable committee. Members may be represented at any meeting by another person designated by the absent Member. The JSC shall be chaired by a [* * *] Member ("**Chairperson**"). The initial Chairperson of the JRC shall be a [* * *] Member and shall thereafter [* * *].

7.4 Meetings
The Chairperson for a given Committee or his/her delegate will be responsible for sending invitations and agendas for all such Committee meetings to all Members at least [* * *] before the next scheduled meeting of the Committee. The venue for the meetings shall be agreed by the Committee. Each Committee (after its formation in accordance with Section 7.1 or 7.2, as applicable) shall hold meetings at least [* * *] per Calendar Year, either in person or by tele-/video-conference, and in any case as frequently as the Members of the applicable Committee may agree shall be necessary, but not more than four times a year, provided that such limit shall not apply to meetings held following a material change to the Development or Commercialization of a Lead Product or Hybrid Product that occurs between planned annual updates at the JSC in accordance with Section 7.10. The Alliance Director of each Party may attend the JSC meetings as a permanent participant.

7.5 Minutes
The Chairperson of a given Committee will be responsible for designating a Member to record in reasonable detail and circulate draft minutes of the Committee meetings to all members of the Committee for comment and review within [* * *] after the relevant meeting. The Members of the Committee shall have [* * *] to provide comments. The Party preparing the minutes shall incorporate timely received comments and distribute finalized minutes to all Members of the Committee within [* * *] of the relevant meeting. The Chairperson approves the final version of the minutes before its distribution.

7.6 Responsibilities of the JRC
The JRC shall have the responsibility and authority to: [* * *]

The JRC shall have no responsibility and authority other than that expressly set forth in this Section such as to unilaterally impose financial or manpower obligations on either Party.

7.7 JRC Decisions

7.7.1 Decision Making Authority

The JRC shall decide matters within its responsibilities set forth in Section 7.6.

7.7.2 Consensus; Good Faith

The Members of the JRC shall act in good faith to cooperate with one another and seek agreement with respect to issues to be decided by the JRC. The Parties shall endeavor to make decisions by consensus with each Party having one (1) vote.

7.7.3 Failure to Reach Consensus

If the JRC is unable to decide a matter by consensus:

(a) Dicerna shall be responsible for [* * *].

(b) Roche shall have the final decision authority on [* * *].

Any such decision shall constitute a decision of the JRC.

7.8 JSC Responsibilities and Decision Making for Shared Product Development

7.8.1 JSC Responsibilities

With respect to Shared Product Development, the role of the JSC shall be to oversee and manage the global Development activities of Shared Products, which oversight and management shall be in alignment with Roche's then current procedures as they would apply to an internal Roche development program at the equivalent stage of development having a similar commercial value, subject to the obligations set forth in this Agreement. The JSC may establish and oversee JOTs as applicable to Shared Product Development. In particular with regard to Shared Product Development, the JSC's primary activities shall include: [* * *]

The JSC shall have no responsibility and authority other than that expressly set forth in this Section.

7.8.2JSC Decision Making

The Members of the JSC shall act in good faith to cooperate with one another and seek agreement with respect to issues to be decided by the JSC concerning Shared Product Development. The Parties shall endeavor to make decisions by consensus with each Party having one (1) vote.

7.8.3 Failure to Reach Consensus

(a) Subject to Section 7.8.3(b), if the JSC is unable to decide a matter, the resolution and/or course of conduct shall be determined by Roche, in its sole discretion; provided that, Roche shall not have the authority to make any decision without the consent of Dicerna that would result in an increase in Dicerna's patent infringement risk under this Agreement.

(b) If the JSC cannot resolve an issue which relates to:

(i) continuing or discontinuing the [* * *];

(ii) continuing or discontinuing any [* * *];

(iii) a decision to [* * *]; or

(iv) a decision to pursue or not to pursue a [* * *],

then the JSC (or either Party's members thereof) may refer such dispute to [* * *]. Any such decision shall constitute a decision of the JSC.

7.9 JSC Responsibilities and Decision Making for Co-Promotion Products

The provisions of this Section 7.9 apply only with respect to Co-Promotion Products during such time as Dicerna has a Co-Promotion Right in the US for such Co-Promotion Products.

7.9.1 JSC Responsibilities

With respect to Co-Promotion activities, the role of the JSC shall be to oversee and coordinate the US Co-Promotion activities in the US for Co-Promotion Products in accordance with the Co-Promotion Agreement. For Co-Promotion Products, the JSC will have responsibility for reviewing the Commercialization Plan from time to time as necessary for the purpose of considering appropriate amendments thereto.

7.9.2 JSC Decision Making

The Members of the JSC shall act in good faith to cooperate with one another and seek agreement with respect to issues to be decided by the JSC concerning Co-Promotion of Co-Promotion Products. The Parties shall endeavor to make decisions by consensus with each Party having one (1) vote.

7.9.3 Failure to Reach Consensus

If the JSC is unable to decide a matter regarding Co-Promotion of Co-Promotion Products, then the JSC (or either Party's members thereof) may refer such dispute to [* * *], subject to the terms of this Agreement and the Co-Promotion Agreement.

7.10 JSC Responsibilities for Roche Sole Development/Commercialization of Lead Product and Hybrid Product

During the lifetime of the JSC pursuant to Section 7.15, the JSC shall be a forum for information exchange from Roche to Dicerna on the status of Development and Commercialization of the Lead Product and Hybrid Products if Dicerna does not exercise its Cost Share Option. Through the JSC, Roche shall provide updates regarding (i) Development of the Lead Product and Hybrid Product in accordance with Section 6.4 including progress since the last update and (ii) Commercialization of the Lead Product and Hybrid Product in accordance with Section 10.3. Such updates shall be consistent with the information Roche provides its internal management on Lead Products. In the event of a material change to the Development or Commercialization of a Lead Product or Hybrid Product that occurs between planned annual updates at the JSC, Roche's Alliance Director shall timely inform Dicerna of such change after which the Parties may decide whether an ad hoc JSC meeting should be scheduled. Where there is no JSC, updates on the Lead Product will be provided through the Alliance Director in accordance with Section 7.12.

7.11 Joint Operational Teams

Each Committee may establish JOTs from time-to-time, with a defined scope and duration, to carry out the activities of such Committee. Each of the JOTs shall be composed of representatives designated by each Party and the Parties need not have the same number of representatives. The JOTs shall include individuals with expertise and responsibilities appropriate (in terms of their seniority, availability, function in their respective organizations, training and experience) for the tasks then being undertaken and the stage of the research, manufacture, development and commercialization of applicable Compounds and Products for which joint activities will be performed. Each Party shall designate one of its representatives as its primary contact for all JOT matters (such Party's "**JOT Co-Leader**"). A Party may replace any or all of its representatives (and designated JOT Co-Leader) at any time by informing the other JOT Co-Leader in advance, in writing (which may be by email). Roche's JOT Co-Leader for a given JOT shall be responsible for keeping minutes of any JOT meetings that record in writing all decisions made, action items assigned or completed, and other appropriate matters. Meeting minutes shall be sent to both Parties within [* * *] after a meeting for review, comment and approval by each Party.

7.12 Alliance Director

Each Party shall appoint one person to be its point of contact with responsibility for facilitating communication and collaboration between the Parties (each, an "**Alliance Director**"). The Alliance Directors shall be permanent participants of the Committee meetings (but not members of the Committee) and may attend JOT meetings as appropriate. The Alliance Directors shall facilitate resolution of potential and pending issues and potential disputes to enable the Committees to reach consensus and avert potential disputes. The Alliance Director will be the point of contact for communicating regular updates and shall provide such regular updates about Development and Commercialization for Licensed Products except where updates are otherwise handled by the JSC in accordance with this Agreement. Upon Dicerna's request, the Alliance Director shall discuss and answer Dicerna's reasonable questions regarding the information received from Roche under Sections 6.4 and 10.3. In the event of a material change to the Development or Commercialization of a Licensed Product, Roche's Alliance Director shall timely inform Dicerna of such change in accordance with Sections 6.4, 7.10, and 10.3, and to the extent the JSC does not meet to discuss such material change or there is no JSC, Roche's Alliance Director shall discuss such change with Dicerna and provide further information as may be reasonably requested by Dicerna regarding such change.

7.13 Limitations of Authority
No Committee shall have the authority to amend or waive any terms of this Agreement.

7.14 Expenses
Each Party shall be responsible for its own expenses including travel and accommodation costs incurred in connection with the Committees.

7.15 Lifetime of JRC and JSC
The JRC shall exist until the later of (i) the end of the R&D Collaboration Term unless terminated earlier (or if it does not come into existence), (ii) the expiration of Dicerna's Cost Share Option without Dicerna exercising its Cost Share Option and (iii) if Dicerna exercises its Cost Share Option, the timely transfer of Cost Share Option activity oversight to the JSC. The JSC shall exist for such time as (x) there is a Shared Product that Dicerna is co-funding or Dicerna is Co-Promoting Co-Promotion Products under its Co-Promotion Right, and otherwise (y) until the earlier of the [* * *] anniversary of the First Commercial Sale of the Lead Product in the Territory or Roche's termination of Development or Commercialization of the Lead Product. In addition, if Dicerna becomes an Acquired Party, Roche may restrict Dicerna's participation in the JSC in accordance with and subject to the limitations in Section 20.2.3. Following any automatic cessation or earlier disbandment of a Committee, the Committee shall have no further obligations under this Agreement and shall perform no further functions hereunder unless and until relevant activities commence in the future (in which case the Committee shall be reconstituted).

8. Manufacture and Supply

8.1 Dicerna Phase I Study
Dicerna shall have responsibility at its own expense for the clinical supply of the Lead Product for the Dicerna Phase I Study.

8.2 R&D Collaboration
During the Target Term with respect to Compounds Directed To a given Selected Target, except where otherwise set forth in the applicable Research Plan, Dicerna shall have responsibility at its own expense for the supply of Additional Dicerna Compounds for use in research activities conducted by Dicerna

up to Initiation of GLP Tox Study for such Compound. Roche shall pay Dicerna's fully burdened manufacturing costs for supply of Additional Dicerna Compounds as requested by Roche for use in activities that will occur after Initiation of GLP Tox Study, and otherwise Roche shall have responsibility at its own expense for the supply of all Compounds, in each case for use in the R&D Collaboration. For avoidance of doubt, any supply of Additional Dicerna Compounds by Dicerna to Roche prior to the Initiation of GLP Tox Study for use in or after the Initiation of GLP Tox Study (including manufacturing reservation and cancelation fees incurred under the Research Plan), shall be reimbursed to Dicerna by Roche. During the Target Term Dicerna shall provide Roche with reasonable access during Dicerna's business hours to employees and Third Party CROs with relevant subject matter expertise to answer questions and assist Roche in potential preparation for Dicerna Selected Target Transfer Activities.

8.3 Roche Responsibilities

Other than Dicerna's supply responsibilities under Sections 8.1 and 8.2 and Dicerna's Transfer Activities (and subject to Section 6.3), (i) Roche shall otherwise be solely responsible at its own expense for the manufacture and supply of all pre-clinical and clinical supplies of Compounds and Products, either by itself or through Third Parties, and (ii) Roche shall be solely responsible at its own expense for the commercial manufacture and commercial supply of Lead Products for sale in the Territory, either by itself or through Third Parties. After the Effective Date, Roche will commence technical development in order to have established required processes and material for Roche's Development needs.

8.4 Transfer Activities for Manufacturing

8.4.1 Lead Transfer Activities

As part of the Lead Transfer Activities for manufacturing, and in order to help establish the start of Roche's production processes as soon as practicable, Dicerna shall supply Roche with [* * *] of the Lead Compound for solubility, stability testing, other technical development activities and non-clinical drug development activities and offer such other assistance as Roche reasonably requests after the Effective Date. Roche will not use such samples in humans. [* * *].

As soon as practicable after the Effective Date, Dicerna will provide Roche with the chemical raw materials ("**Chemical Raw Materials**") identified in the Lead Transfer Plan or as otherwise reasonably requested by Roche, which are reasonably necessary for Roche's technical development and manufacturing of Roche's own material that will be used for Roche Development. Dicerna and Roche will timely liaise about the demand-supply setup for these Chemical Raw Materials for ensuring timely supply and availability of sufficient amounts in order to keep up with Roche Development timelines.

As soon as practicable after the Effective Date and if necessary as soon as practicable after Completion of the Dicerna Phase I Study (recognizing Dicerna's responsibilities in Completion of the Dicerna Phase I Study), Dicerna shall initiate remaining Lead Transfer Activities associated with CMC and manufacturing, which may include providing reasonable assistance to enable Roche (or Roche's designee(s)) to manufacture Lead Transfer Compounds and Lead Products and obtaining all necessary Regulatory Approvals or modifying existing Regulatory Approvals for the manufacture by Roche, including by reviewing and commenting on documents to be submitted by Roche to a Regulatory Authority, upon reasonable request from Roche. Dicerna shall use reasonable efforts to maintain in full force and effect agreements and relationships with Third Parties in effect as of the Effective Date so that Roche has access to non-clinical and clinical supply, as reasonably requested by Roche, prior to and during any manufacturing transition from Dicerna to Roche.

Unless otherwise specified in this Agreement or the Lead Transfer Plan or as agreed to by the Parties, the following shall apply: shipment of Chemical Raw Materials and any other Materials that Dicerna or Dicerna's designees are to provide to Roche shall be shipped free of charge DAP Roche Basel or Roche's designee (Incoterms 2010).

8.4.2 Selected Target Transfer Activities

Prior to selection of a presumed-to-be Clinical Candidate, the JRC may permit Dicerna to manufacture quantities of the applicable Additional Dicerna Compound, at Roche's expense at Dicerna's fully burdened Manufacturing cost, in preparation for or use in cGLP toxicology studies to commence after selection by the JRC of such Clinical Candidate, in which case Dicerna shall invoice Roche after each Calendar Quarter in which Dicerna supplies such Additional Dicerna Compounds with a description the amounts supplied in reasonable detail, and Roche shall pay each such invoice within [* * *] after receipt. Dicerna shall initiate the Selected Target Transfer Activities within [* * *] of the selection of a Clinical Candidate for a given Selected Target (or as otherwise may be set forth in an applicable Selected Target Transfer Plan) to enable Roche (or Roche's designee(s)) to manufacture the Selected Target Transfer Compounds. Unless specifically requested by Roche or as otherwise stated in the applicable Selected Target Transfer Plan, Dicerna shall use reasonable efforts to maintain in full force and effect agreements and relationships with Third Parties in effect as of the Effective Date so that Roche has access to non-clinical supply prior to and during any manufacturing transition from Dicerna to Roche.

9. Regulatory

9.1 Dicerna Responsibility

Prior to Completion of the Dicerna Phase I Study, [* * *].

During such time:

(a) In consultation with Roche, Dicerna shall use Commercially Reasonable Efforts to make a submission for an IND in the US with the FDA by [* * *].

(b) Roche shall have the right to reasonably attend regulatory interactions (including face-to-face meetings and phone calls) with Regulatory Authorities for the Lead Product to the extent permitted by Applicable Law. Dicerna shall give notice of any such meeting within [* * *] after Dicerna first receives notice of the scheduling of such meeting. In addition, Roche may participate in any preparatory pre-meetings held prior to a Regulatory Authority meeting.

(c) Dicerna will coordinate with Roche on its material communications with and material Regulatory Materials submitted by Dicerna to any Regulatory Authority in connection with the Lead Product and Dicerna Phase I Study, including all CTA submissions, CTA amendments, Regulatory Authority meeting requests and Regulatory Authority advice (including scientific advisory packages). In particular Dicerna shall provide copies of draft Regulatory Authority meetings requests, Regulatory Authority advice (including scientific advisory packages) and any other material submissions and communications (including written summaries of material oral communications proposed or conducted by or on behalf of Dicerna) with any Regulatory Authority pertaining to the Lead Compound or Lead Product sufficiently in advance, where reasonable, for Roche to comment on any such Regulatory Materials or communications with any Regulatory Authority, and Dicerna shall give due consideration in good faith to any comments provided by Roche in relation to such Regulatory Materials or communications with any Regulatory Authority. As used in this

Section 9.1(c), material communications include all formal communications or communications that impact the Dicerna Phase I Study.

9.2 Transfer to Roche

The following shall be part of the Lead Transfer Activities, specifically with respect to regulatory affairs. All such Lead Transfer Activities shall commence in accordance with the timeline in the Lead Transfer Plan or as otherwise reasonably practical (in view of the Dicerna Phase I Study) to facilitate Roche's preparation for continued Development of the Lead Compound.

After Roche's reasonable request (unless not allowed by Applicable Law) or in accordance with the Lead Transfer Plan, Dicerna shall use reasonable efforts to transfer sponsorship of the existing CTAs to the Roche Affiliate designated by Roche, and the Parties will cooperate to draft and execute the necessary documents required to effect such transfer. Prior to the CTA transfer, Dicerna shall provide to Roche copies of all material correspondence with the Regulatory Authorities. For all completed study reports, Dicerna shall provide reasonably necessary documentation to confirm data reliability, as required by Article 43 of the Japanese Pharmaceutical Affairs Law Enforcement Regulations and related notifications, including original author signatures, raw data lists, cGLP and GCP compliance information. All documentation will be provided in English.

After Roche's reasonable request or as in accordance with the Lead Transfer Plan, Dicerna shall transfer to Roche all relevant historical clinical safety data. Safety information on serious adverse events shall be provided in CIOMS format and safety information on non-serious adverse events shall be provided in English Line Listing format, inclusive of source documentation (e.g. lab data, discharge forms etc.).

9.3 Roche Responsibility

Other than Dicerna's rights and obligations for regulatory activities set forth in this Article 9 (and subject to Section 6.3), Roche shall be solely responsible at its own expense for all regulatory affairs related to Compounds and Products in the Territory including the preparation and filing of applications for Regulatory Approval, as well as any or all governmental approvals required to develop, have developed, make, have made, use, have used, manufacture, have manufactured, import, have imported, sell and have sold Products. Roche shall be responsible for pursuing, compiling and submitting all regulatory filing documentation, and for interacting with regulatory agencies, for all Products in all countries in the Territory. Roche or its Affiliates shall own and file in their discretion all regulatory filings and Regulatory Approvals for all Products in all countries of the Territory.

9.4 Reporting Adverse Events

Each Party will promptly disclose to the other Party during the Agreement Term information in such Party's possession and control concerning side effects, injury, toxicity or sensitivity reaction and incidents or severity thereof in humans with respect to any Licensed Product.

After the transfer of historical clinical safety data from Dicerna (including adverse events, discontinuations, laboratory data, ECGs and vital signs), Roche or its designated Affiliate, at its sole cost, shall report to appropriate authorities in accordance with local requirements all adverse events related to use of the Products in the Territory.

9.4.1 Pharmacovigilance Agreement

If requested by a Party or as otherwise required by Applicable Law, the Parties shall execute one or more separate Pharmacovigilance Agreement(s) which set forth the responsibilities and obligations

of the Parties with respect to the procedures and timeframes for compliance with all Applicable Laws pertaining to safety reporting and their related activities of the (i) applicable Product(s) in the Territory, (ii) responsibilities of Dicerna and Dicerna's Third Party licensees with respect to other GalXC Molecules, and (iii) if Dicerna exercise its Co-Promotion Option, in connection with Dicerna's Co-Promoting of the Co-Promotion Products in the US.

10. Commercialization

10.1 Generally

Subject to Dicerna's Co-Promotion Option and subject to Article 4, Roche, at its own expense, shall have sole responsibility and decision making authority for the marketing, promotion, sale and distribution of Products in the Territory.

10.2 Booking of Sales; Distribution

Roche shall have the sole right to (a) invoice and book sales of Products, establish all terms of sale (including pricing and discounts), warehouse and distribute Products in the Territory and to perform or cause to be performed all related services, (b) handle all order processing, invoicing, collection, distribution, reimbursement services and inventory management with respect to such Products in the Territory, (c) handle all returns, recalls or withdrawals with respect to any Product in the Territory, (d) handle all payer/distributor account management with respect to any Product in the Territory, and (e) manage all aspects of contracting with providers, distributors, managed care vendors or payers with respect to any Product in the Territory.

10.3 Updates other than Co-Promotion Products in the Co-Promotion Territory

Except as otherwise set forth in Section 7.10, upon request of Dicerna, Roche shall update Dicerna regarding the Commercialization of Products in the Territory (other than Co-Promotion Products in the Co-Promotion Territory) by Roche, its Affiliates and Sublicensees. If Dicerna requests an update, Roche shall provide a high-level summary, in writing and/or through a meeting (face to face/ tele-presence/videoconference or telephone). Dicerna shall not request an update more frequently than once per Calendar Year.

10.4 Product Trademarks

Roche shall have the sole right and responsibility to determine the Product trademarks to be used with the Products on a worldwide basis and to own such trademarks in accordance with Section 15.2, provided that if applicable Roche shall include in Co-Promotion Product labeling in the US appropriate reference to Dicerna's company trademark(s). Neither Party shall, nor shall either Party permit its Affiliates or Sublicensees to (a) use in their respective businesses, any trademark that is confusingly similar to, misleading or deceptive with respect to or that dilutes any (or any part) of the Product trademarks, or (b) do any act which endangers, destroys or similarly affects, in any material respect, the value of the goodwill pertaining to the Product trademarks. Each Party agrees to conform (x) to the customary industry standards for the protection of Product trademarks for pharmaceutical products and such guidelines of Roche with respect to manner of use (as provided in writing by Roche) of the Product trademarks and (y) to maintain the quality standards of Roche with respect to the goods sold and services provided in connection with such Product trademarks. Neither Party shall do any act which endangers, destroys or similarly affects, in any material respect, the value of the goodwill pertaining to the Product trademarks.

10.5 Product Labeling; Markings and Co-Branding

Roche shall own and be responsible for all Product Labeling for all Products in accordance with the terms of this Agreement including, for Co-Promotion Products, Sections 10.4 and 15.2. Roche will comply with all Applicable Law relevant to patent marking and the Parties shall work together to include all relevant Patent Rights for such marking.

10.6 Dicerna US Co-Promotion Option

10.6.1 Option

If Dicerna exercises its Cost Share Option, then Dicerna also shall have the option (the "**Co-Promotion Option**") to assume between [* * *] of the total sales force for each Shared Product measured in terms of Sales Representatives in the Co-Promotion Territory (the "**Co-Promotion Right**"). The Parties shall agree to a specific percentage within this range as part of the Co-Promotion Agreement. Notwithstanding the foregoing, Shared Products that are Combination Products containing an Encumbered Combination Agent are not subject to the Co-Promotion Option and Co-Promotion Right set forth herein.

10.6.2 Notice and Exercise

(a) Approximately [* * *] before the anticipated filing of the first MAA for a given Shared Product, Roche will deliver and present to and discuss with the JSC the applicable Commercialization Plan, including Roche's preliminary estimate of the number of Sales Representatives it anticipates for such Shared Product for such launch in the Co-Promotion Territory (the "**Roche Estimate**"). In addition to information received through the JSC, Dicerna may submit written questions to Roche about the Commercialization Plan for such Shared Product ("**Shared Product Questions**") within [* * *] of the receipt of such Roche Estimate, in which case Roche will respond to such timely-delivered questions no later than [* * *] from receipt of Dicerna's questions (the date of such delivery of all answers, the "**Roche Response Date**"). Dicerna may exercise its Co-Promotion Option by giving written notice thereof to Roche no later than the end of the Co-Promotion Exercise Period, all in accordance with Section 10.6.2(b).

(b) As conditions precedent to exercising a Co-Promotion Option for a Shared Product and maintaining the Co-Promotion Right for such Co-Promotion Product, Dicerna must:

(i) establish, by means of a presentation to Roche as of the time of exercise, that it has (A) an already established internal sales management organization and infrastructure to conduct Dicerna's Co-Promotion activities for such Co-Promotion Product and (B) a plan to hire, retain or otherwise build a sales force consisting of direct employees of Dicerna that will be in place no later than [* * *] after the First Commercial Sale of such Co-Promotion Product with the number of Sales Representatives that Dicerna is required to use, each of whom has prior experience promoting pharmaceutical products to prescribing physicians in the Co-Promotion Territory and meets the qualifications set forth in Appendix 10.6.3; and

(ii) as of the time of exercise, and for so long as Dicerna is Co-Promoting such Co-Promotion Product hereunder and under the Co-Promotion Agreement, not be developing or commercializing by itself or in collaboration with a Third Party, either (A) another product that treats HBV or that (B) is an Encumbered Combination Agent.

(c) If Dicerna does not provide the election notice described in Section 10.6.2(a) prior to expiration of the applicable Co-Promotion Exercise Period or if Dicerna does not meet the requirements set forth in Section 10.6.2(b), Dicerna shall be deemed to have irrevocably waived its right to Co-Promote such Shared Product. Any election notice provided by Dicerna at a time when Dicerna

does not meet the requirements set forth in Section 10.6.2(b) shall be void and have no effect. Following Dicerna's exercise of its Co-Promotion with respect to a particular Co-Promotion Product, if that Co-Promotion Product subsequently attains Regulatory Approval in an Encumbered Combination Indication, Dicerna shall not engage in the Detailing or other Co-Promotion Activities for the Co-Promotion Product in the Encumbered Combination Indication, except as provided for in the Co-Promotion Agreement. If Dicerna does not exercise its Co-Promotion Option (or if it has been deemed to have waived its Co-Promote Right pursuant to this Section 10.6.2(c)) for a given Shared Product for the First Eligible Co-Promotion Indication, Dicerna shall not have the right to exercise its Co-Promotion Option with respect to any subsequent Regulatory Approvals or label expansion granted for such Shared Product. As used in this Section 10.6.2(c), the "**First Eligible Co-Promotion Indication**" for a Co-Promotion Product is the first indication for which Regulatory Approval in the Co-Promotion Territory is obtained that is not an Encumbered Combination Indication.

10.6.3 Co-Promotion Agreement

Promptly after Dicerna's first exercise of a Co-Promotion Option for a Co-Promotion Product, and subject to Dicerna's compliance with the requirements of Section 10.6.2(b)(b), the Parties shall negotiate in good faith and enter into a written agreement for Co-Promotion (the "**Co-Promotion Agreement**") setting forth the terms of Dicerna's and Roche's Co-Promotion rights and obligations (including the specific percentage of the total sales force in the range permitted under Section 10.6.1) with regard to such Co-Promotion Product in accordance with the terms and conditions in this Agreement (including this Article 10, including Sections 10.6.2(b)(b), 10.6.4 and 10.6.5, and those set forth in Appendix 10.6.3). The Parties shall negotiate with such diligence as is required to enter into and execute the Co-Promotion Agreement within [* * *] following such exercise, or such other date as the Parties may agree in writing. The Parties shall promptly amend the Co-Promotion Agreement upon each subsequent exercise by Dicerna of a Co-Promotion Option with regard to a new Shared Product in accordance with the terms and conditions in this Article 10 and Appendix 10.6.3. In addition to any other terms agreed to by the Parties, the Co-Promotion Agreement shall contain the terms set forth in Appendix 10.6.3 of this Agreement. Unless otherwise agreed to by the Parties, Dicerna may not commence Co-Promotion on Co-Promotion Products until such time as the Parties enter into the Co-Promotion Agreement.

10.6.4 General Requirements for Co-Promotion Activities

Dicerna's Co-Promotion Rights shall only exist during such time as Dicerna has the Cost Share Right.

Dicerna may not use contract sales forces to fulfill its Co-Promote obligations for more than [* * *] after the First Commercial Sale of the first Co-Promotional Product. Any Dicerna Sales Representatives involved in a sales call for one or more Co-Promotion Product(s) shall devote at least [* * *] of its sales call time until the [* * *] anniversary of First Commercial Sale in the US and thereafter at least [* * *] of such call time to the Co-Promotion Product(s). Under the Co-Promotion Agreement, Roche shall have the sole right to control all decisions with respect to the co-promotion arrangement, including the call plans and assigned territories of Dicerna Sales Representatives, the promotional materials to be used, the training and testing applicable to such Sales Representatives, and restrictions with respect to the ability of such Sales Representatives to Detail other products. "**Co-Promote**", "**Co-Promoting**" or "**Co-Promotion**" means the US Detailing activities assigned to Dicerna in the Co-Promotion Agreement, and shall not include any Medical Affairs Activities, sale or distribution of such Co-Promotion Product in the Co-Promotion Territory by Dicerna or its Affiliates. Dicerna shall have the right to terminate its Co-Promotion Rights for a Co-Promotion Product with [* * *] prior written notice

to Roche, in which case, the Parties shall reasonably cooperate to transition to Roche, upon the effective date of such termination, all of Dicerna's Co-Promotion activities to such Co-Promotion Product so as to minimize disruption to sales activity, the details of which shall be further set forth in the Co-Promotion Agreement.

10.6.5 Change of Control

Section 20.2.3 shall apply in the event of a Dicerna Change of Control.

10.7 Medical Affairs

Roche shall have the sole right and responsibility to conduct and make decisions regarding Medical Affairs Activities with respect to any Product. For clarity, Roche shall retain such sole right and responsibility in the event that Dicerna exercises its Co-Promotion Option. For further clarity, Dicerna's Sales Representatives shall be supported by Roche's Medical Affairs personnel.

11. Payments to Dicerna

11.1 Upfront License Fee for Lead Compound and Selected Targets

Within [* * *] after the Effective Date and receipt of an invoice from Dicerna, Roche shall pay to Dicerna a non-refundable, non-creditable upfront payment of Two Hundred Million US Dollars (US$ 200,000,000). For the avoidance of doubt, upon the Effective Date, such payment is due and payable and is required to be paid as provided in this Section 11.1, notwithstanding any termination under this Agreement or failure to select any targets and/or to commence the R&D Collaboration.

11.2 Development and Regulatory Event Payments

11.2.1 Lead Products

Roche shall pay up to a total of [* * *] in relation to the achievements of events with respect to Lead Products. The development and regulatory event payments under this Section 11.2.1 shall be paid by Roche according to the following schedule of development and regulatory events.

Development and Regulatory Event	Dollars (in millions)
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]

The Initiation of Pivotal Study event payment will be reduced by [* *], i.e. from [* * *], if Dicerna exercises its Cost Share Option.

Each development event payment shall be paid only once, the first time the first Lead Product reaches the applicable triggering event, regardless the number of times such events are reached and by how many Lead Products. [* * *].

For the avoidance of doubt, development event payments due on a Lead Product under this Section 11.2.1 shall continue to be due at the rate applicable to Lead Products (not Hybrid Products) until the applicable Lead Product has achieved its First Commercial Sale in such jurisdiction as a product not containing a Selected Target Compound.

11.2.2 Selected Target Products and Hybrid Products

For each Selected Target Product and Hybrid Product, Roche shall pay up to a total of [* * *] in relation to the achievements of events with respect to Selected Target Products and Hybrid Products. The development and regulatory event payments under this Section 11.2.2 shall be paid by Roche according to the following schedule of development and regulatory events.

Development and Regulatory Event	Dollars (in millions)
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]

* Payable upon the earlier of [* * *].

**** [* * *]

Each development and regulatory event payment shall be paid only once for each Selected Target Product or Hybrid Product, the first time each Selected Target Product or Hybrid Product reaches the applicable triggering event, regardless of the number of times such events are reached by such Selected Target Product. For purposes of this Section 11.2.2, with respect to events 1 through 4, [* * *] Selected Target Products are considered the same Selected Target Product if they contain different Selected Target Compounds that target the same Selected Target. If any of events 5 through 7 above are achieved by a Selected Target Product, any of events 1 through 4 not previously achieved by such Selected Target Product shall be deemed to have been achieved at the time of achievement of events 5 through 7, as applicable, and the corresponding milestone payment shall be owed.

11.2.3 Development and Regulatory Event Payment Invoicing and Timing

Upon occurrence of each development and regulatory event in this Section 11.2, Roche shall notify Dicerna within [* * *] of the event and pay the corresponding development and regulatory event payment to Dicerna within [* * *] of the event and receipt of an invoice from Dicerna. Each such payment shall be non-refundable and non-creditable.

11.3 Sales Based Events

Roche shall pay to Dicerna up to a total of [* * *] based on the Calendar Year Net Sales of the Lead Product and Hybrid Product in the Territory:

Sales Based Events for Net Sales			Dollars (in millions)
No.	**Lead Product**	**Hybrid Product**	
[* * *]	[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]	[* * *]
[* * *]			[* * *]

Each of the sales based event payments 1-5 shall be paid no more than once each, irrespective of whether or not the previous sales based event payment was triggered by a Lead Product or a Hybrid Product, and whether or not the previous sales based event payment was triggered by the same or by a different applicable Product, and shall be non-refundable and non-creditable. Roche will notify Dicerna of the achievement of sales based events within [* * *] after the end of the Calendar Quarter in which the event first occurs for the Lead Product or Hybrid Product in the Territory first reaching the respective Net Sales Threshold, and will pay Dicerna the corresponding milestone within [* * *] of receipt of an invoice. For the avoidance of doubt, if more than one sales based event occurs in any Calendar Year, all such sales based event payments shall be payable for such Calendar Year.

11.4 Royalty Payments

11.4.1 Royalty Term

On a Product-by-Product basis, Roche shall pay to Dicerna royalties on Net Sales of such Product during the applicable Royalty Term. Thereafter upon expiration of the applicable Royalty Term, the licenses granted to Roche for a given Product shall be fully paid up, irrevocable and royalty-free.

11.4.2 Royalty Rates

11.4.2.1 Lead Product

The following royalty rates shall apply to the respective tiers of aggregate Calendar Year Net Sales of a Lead Product per area of the Territory, on an incremental basis, as follows:

(a) For the [* * *]

Royalty rates depend if the Lead Product is a Shared Product or is not a Shared Product.

Tier of Calendar Year Net Sales in million US$	Percent (%) of Net Sales	
	Shared Product	Not a Shared Product
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]

(b) For aggregate countries of the Territory other than US:

Tier of Calendar Year Net Sales in million US$	Percent (%) of Net Sales
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]

For example, if Net Sales of a Lead Product [* * *]that is not a Shared Product, for a given Calendar Year, are [* * *], then royalties owed to Dicerna on such Net Sales of such Product for that Calendar Year shall equal * * *]calculated as follows:

[* * *]

For the avoidance of doubt, royalty payments on a Lead Product in a given country will not be affected because a Hybrid Product is also being sold in the same or another country.

11.4.2.2 Selected Target Product

The following royalty rates shall apply to the respective tiers of aggregate Calendar Year Net Sales of a Selected Target Product per area of the Territory, on an incremental basis, as follows:

(a) For [* * *]

Tier of Calendar Year Net Sales in million US$	Percent (%) of Net Sales
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]

(b) For aggregate countries of the Territory other than [* * *]

Tier of Calendar Year Net Sales in million US$	Percent (%) of Net Sales
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]

For example, if Net Sales of a Selected Target Product [* * *], for a given Calendar Year, are [* * *], then royalties owed to Dicerna on such Net Sales of such Product for that Calendar Year shall equal [* * *] calculated as follows:

[* * *] royalty payment

11.4.3 Hybrid Product

The following royalty rates shall apply to the respective tiers of aggregate Calendar Year Net Sales of a Hybrid Product per area of the Territory, on an incremental basis, as follows:

(a) For [* * *]:

Royalty rates depend if the Hybrid Product is a Shared Product or is not a Shared Product.

Tier of Calendar Year Net Sales in million US$	Percent (%) of Net Sales	
	Shared Product	Not a Shared Product
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]

(b) For aggregate countries of the Territory other than [* * *]:

Tier of Calendar Year Net Sales in million US$	Percent (%) of Net Sales
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]

The above royalty rates in Section 11.4.3 shall apply to a Hybrid Product until the later of [* * *].

11.4.3.2 Royalty Adjustments

For the purpose of calculating royalties of a given Product under this Section 11.4.2, Calendar Year Net Sales and the royalty rates shall be subject, as applicable, to the following adjustments in this Section 11.4.

11.4.4 Combination Product

If Roche or its Affiliates intend to sell a Combination Product, then the Parties shall meet approximately [* * *] prior to the anticipated First Commercial Sale of such Combination Product in the Territory to negotiate in good faith and agree to an appropriate adjustment to Net Sales to reflect the relative commercial value contributed by the components of the Combination Product (the "**Relative Commercial Value**"). If, after such good faith negotiations not to exceed [* * *], the Parties cannot agree to an appropriate adjustment, the dispute shall be initially referred to the executive officers of the Parties in accordance with Section 22.2.

If the Parties are unable to agree on the Relative Commercial Value within [* * *] of such referral, then the Relative Commercial Value shall be determined by the following procedure. Roche will select one (1) individual who would qualify as an Expert, Dicerna will select (1) individual who would qualify as an Expert, and those two (2) individuals shall select one (1) individual who would qualify as an Expert and who shall be chairman of a committee of the three Experts (the "**Expert Committee**"), each with a single deciding vote. The Expert Committee will promptly hold a meeting to review the issue under review, at which it will consider memoranda submitted by each Party at least [* * *] before the meeting, as well as reasonable presentations that each Party may present at the meeting. As part of the Expert Committee's consideration, the Parties agree that the Relative Commercial Value of the Lead Product within a Combination Product shall not be less than (a) [* * *] if the first Filing for Regulatory Approval is (or is planned to be, as applicable) for use with one additional Non-Compound Active Agent Controlled by Roche where such compound has a Valid Claim of the composition of matter with at least [* * *]remaining patent life in one or more countries in the Territory or (b) [* * *] if the condition in part (a) is not met. The determination of the Expert Committee as to the issue under review will be binding on both Parties. The Parties will share equally in the costs of the Expert Committee. Unless otherwise agreed to by the Parties, the Expert Committee may not decide on issues outside the scope mandated under terms of this Agreement.

A Hybrid Product shall not be treated as a Combination Product under this Section 11.4.4 with respect to the Lead Compound and Selected Target Compound, however the Relative Commercial Value will be determined if there are other Combination Product components other than the Lead Compound and Selected Target Compound.

11.4.5 No Composition of Matter Claim or Regulatory Exclusivity; Generic Competition

For a given Product, and subject to Section 11.4.7, if in a given country within the Territory there is:

(a) no Composition of Matter Claim of a Party that Covers such Product and no applicable Regulatory Exclusivity for such Product remains in such country; or

(b) entry of a Like-Substance Product has occurred, provided that after such entry there has been a decline of quarterly Net Sales of such Product in such country greater than [* * *] of the average level of the quarterly Net Sales of such Product achieved in the [* * *] immediately prior to such entry;

then the royalty payments due to Dicerna for such Product in such country shall be reduced for the remainder of the Royalty Term by (i) [* * *] for the Major Markets other than [* * *], or (ii) [* * *].

11.4.6 Third Party Payments

Other than for the Existing Third Party In-License Agreement listed in Appendix 16.1.5 (for which Dicerna shall be responsible), Roche shall be responsible for and pay or have paid any consideration owed to any Third Party in relation to Third Party intellectual property rights necessary or useful to make, use or sell Products. With respect to such Third Party Patent Rights that are reasonably necessary for the sale of a given Product in a given country, Roche shall have the right to deduct (x) a maximum of [* * *] of royalties actually paid by Roche to such Third Party with respect to such arrangement from (y) royalty payments otherwise due and payable by Roche to Dicerna for such Product in such country under this Agreement. Any such deduction shall be made only on a Product-by-Product and country-by-country basis. Prior to entering into such arrangement, Roche will notify and discuss with Dicerna unless Roche will not deduct payments under such arrangement.

11.4.7 Maximum Deductions

In no event shall the royalty paid to Dicerna for Net Sales of Products hereunder, as reduced by Sections 11.4.5 and 11.4.6, be reduced from the applicable royalty rates set forth in Section 11.4.2 above by more than an amount equal to (i) [* * *] of the royalties otherwise due for Net Sales of such Products for the Major Markets other than [* * *], or (ii) [* * *].

11.4.8 Apportionment of Compulsory Sublicensee Consideration

Compulsory Sublicense Compensation received by the Roche Group from a Compulsory Sublicensee during the Royalty Term shall be shared with Dicerna on an equivalent profit share percentage (the "**Compulsory Profit Share Percentage**") calculated for the respective Calendar Year for the relevant country as follows:

$$[* * *] \quad \frac{[* * *]}{[* * *]}$$

At the end of the Calendar Year, Roche shall pay to Dicerna the Compulsory Sublicense Compensation under a given country multiplied by the Compulsory Profit Share Percentage for such country. For clarity, any sales or payments by Compulsory Sublicensees under a Compulsory Sublicense shall not be considered as Net Sales and shall not give rise to any royalty payment under Section 11.4.2 of this Agreement.

11.5 Disclosure of Payments

Each Party acknowledges that that the other Party may be obligated to disclose this financial arrangement, including all fees, payments and transfers of value made pursuant to this Agreement, as may be advisable or required under Applicable Law, including certain payments by a Party to health care providers the US Sunshine Act.

12. Accounting and reporting

12.1 Timing of Payments

Roche shall calculate royalties on Net Sales quarterly as of March 31, June 30, September 30 and December 31 (each being the last day of an "**Accounting Period**") and shall pay royalties on Net Sales within [* * *] after the end of each Accounting Period in which such Net Sales occur.

12.2 Late Payment

Any payment under this Agreement by either Roche or Dicerna that is not paid on or before the date such payment is due shall bear interest, to the extent permitted by Applicable Law, at [* * *] as reported by Reuters from time to time, calculated on the number of days such payment is overdue.

12.3 Method of Payment

Royalties on Net Sales and all other amounts payable by Roche hereunder shall be paid by Roche in US Dollars (the "**Payment Currency**") to account(s) designated by Dicerna.

12.4 Currency Conversion

When calculating the Sales of any Product that occur in currencies other than the Payment Currency, Roche shall convert the amount of such sales into Swiss Francs and then into the Payment Currency using Roche's then-current internal foreign currency translation method actually used on a consistent basis in preparing its audited financial statements (at the Effective Date, YTD average rate as reported by Reuters).

12.5 Blocked Currency

In a given country, if by reason of Applicable Law (for example governmental restrictions on foreign exchange trade) the local currency is blocked and cannot be removed from such country, Roche will notify Dicerna in writing and

(a) Dicerna will have the right to receive the applicable royalties of Net Sales in such country in local currency by deposit in a local bank designated by Dicerna, or

(b) if such local currency payment is not allowed by reason of Applicable Law or if otherwise requested by Dicerna, then the royalties related to such Net Sales in such country shall continue to be accrued and shall continue to be reported, but such royalties will not be paid until the sales proceeds related to such Net Sales may be removed from such country. At such time as Roche, its Affiliates or their Sublicensees, as the case may be, is able to remove the sales proceeds related to such Net Sales from such country, Roche shall also pay such accrued royalties in Payment Currency using the actual exchange rate which is used to remove such sales proceeds from such country.

12.6 Reporting

With each royalty payment, Roche shall provide Dicerna in writing for the relevant Calendar Quarter on a Product-by-Product basis the following information:

(a) Sales in Swiss Francs;
(b) Net Sales in Swiss Francs and itemized adjustments to arrive at Net Sales;
(c) adjustments made pursuant to Section 11.4.4 (*Combination Product*);
(d) Net Sales in Swiss Francs after adjustments made pursuant to Section 11.4.4 in Swiss Francs;
(e) exchange rate used for the conversion of Net Sales from Swiss Francs to the Payment Currency pursuant to Section 12.4 (*Currency Conversion*);
(f) Net Sales after adjustments made pursuant to Section 11.4.4 in the Payment Currency;
(g) royalty rate pursuant to Section 11.4.2;
(h) adjustments made pursuant to Sections 11.4.5 - 11.4.7; and
(i) total royalty payable in the Payment Currency after adjustments made pursuant to Sections 11.4.5 - 11.4.7.

Roche shall provide an estimate of the Net Sales in the Payment Currency to Dicerna in writing for the relevant Calendar Quarter on a Product-by-Product basis within [* * *] after the end of each Calendar Quarter.

13. Taxes

13.1 Income Taxes

Except as provided in this Section 13.1, each Party shall pay all income and other taxes (including interest) imposed on or measured with respect to its own income accruing or paid to it under this Agreement. Notwithstanding anything in this Agreement to the contrary, if Roche's assignment of this Agreement leads to the imposition of income tax liability on Dicerna that would not have been imposed in the absence of such action or in an increase in such liability above the liability that would have been imposed in the absence of such action, Roche will indemnify and hold harmless Dicerna from any such additional or increased income tax liability (except to the extent that Dicerna or any of its Affiliates can obtain a refund or credit for such amounts, provided that Dicerna will be reimbursed for any reasonable out of pocket costs incurred in obtaining such a refund or credit).

13.2 Withholding Taxes

If provision is made in law or regulation of any country for withholding of taxes of any type, levies or other charges with respect to any royalty or other amounts payable under this Agreement to a Party (the "**Payee**"), then the other Party (the "**Payor**") shall timely pay such tax, levy or charge for and on behalf of the Payee to the proper governmental authority, and shall promptly furnish Payee with appropriate proof of payment of the withheld taxes as well as the official receipts sufficient to enable the Payee to claim credits for such payments of taxes; provided, however, that notwithstanding anything in this Agreement to the contrary, if Roche's assignment of this Agreement leads to the imposition of withholding tax liability on Dicerna that would not have been imposed in the absence of such action or in an increase in such liability above the liability that would have been imposed in the absence of such action, Roche will indemnify and hold harmless Dicerna from any such additional or increased withholding tax liability (except to the extent that Dicerna or any of its Affiliates can reclaim it, provided that Dicerna will be reimbursed for any reasonable out of pocket costs incurred in the reclaim). The Parties shall cooperate and exercise their reasonable best efforts to ensure that any such withholding taxes are mitigated or reduced to the extent possible under the provisions of any Applicable Law, and shall provide the Payee reasonable assistance (including the provision of any tax forms and other information) in order to allow the Payee to obtain the benefit of any present or future treaty against double taxation or exemption from, refund or reduction in taxes which may apply to such payments. To the extent that a Party is required to deduct and withhold taxes on any such payment pursuant to this Section 13.2, such Party will provide the Payee with written notice of the required withholding as promptly as reasonably practical (and in any event, no later than [* * *] prior to making such payment. To the extent such amounts are so deducted and withheld and timely remitted to the relevant tax authorities, such amounts shall be treated for all purposes under this Agreement as having been paid to the Party to whom such amounts would otherwise have been paid.

13.3 Foreign-Derived Deduction Eligible Income Reporting

Roche shall obtain and deliver to Dicerna, on an annual basis and within [* * *] of Dicerna's request to provide, information as reasonably requested by Dicerna and in Roche's possession to meet any documentation requirements imposed by regulations issued under Section 250 of the Internal Revenue Code for the treatment of an appropriate portion of such amounts as "foreign-derived deduction eligible income" within the meaning of Section 250 of the Internal Revenue Code and the regulations thereunder.

13.4 No Partnership for Tax Purposes

As of the Signature Date, the Parties expect that this Agreement will not be treated as a partnership or joint venture for United States federal and state tax purposes.

13.5 Value Added Tax

It is understood and agreed between the Parties that any payments made by any Party under this Agreement are exclusive of any value added tax ("**VAT**") or similar tax imposed upon such payments. Where VAT is properly chargeable in respect of any supply of goods or services made under this Agreement, the Party paying the consideration for that supply will pay the amount of VAT subject to receipt of a valid tax invoice issued in accordance with Applicable Law.

14. Auditing

14.1 Dicerna Right to Audit

Roche shall keep, and shall require its Affiliates and Sublicensees to keep, full, true and accurate books of account containing all particulars that may be necessary for the purpose of calculating all royalties payable under this Agreement. Such books of accounts shall be kept at their principal place of business. At the expense of Dicerna, Dicerna shall have the right to engage an internationally recognized independent public accountant reasonably acceptable to Roche to perform, on behalf of Dicerna, an audit of such books and records of Roche and its Affiliates and Sublicensees that are deemed necessary by the independent public accountant to report on Net Sales of Product for the period or periods requested by Dicerna and the correctness of any financial report or payments made under this Agreement.

Upon timely request and at least [* * *] prior written notice from Dicerna, such audit shall be conducted for those countries Dicerna has specifically requested, during regular business hours in such a manner as to not unnecessarily interfere with Roche's normal business activities. Such audit shall be limited to results in the [* * *] prior to audit notification, and if Dicerna requests an audit for a given Calendar Year, no additional audits may be conducted for such Calendar Year, unless such audit is for cause based on a material finding identified in the initial annual audit. If Dicerna does not request an audit of a given Calendar Year on or before the [* * *] of the end of such Calendar Year, then Dicerna will be deemed to have accepted the royalty payments and reports in such Calendar Year.

Such audit shall not be performed more frequently than [* * *] nor more frequently than [* * *] with respect to records covering any specific period of time unless there are adverse findings that the independent public accountant determines requires further examination or review of records.

All information, data documents and abstracts herein referred to shall be used only for the purpose of verifying royalty statements, shall be treated as Roche's Confidential Information subject to the obligations of this Agreement and need neither be retained more than [* * *] after completion of an audit hereof, if an audit has been requested; nor more than [* * *] from the end of the Calendar Year to which each shall pertain; nor more than [* * *] after the date of termination of this Agreement.

14.2 Audit Reports

The auditors shall only state factual findings in the audit reports and shall not interpret this Agreement. The auditors shall first discuss their draft audit findings with Roche before sharing such findings with Dicerna and before preparing its draft or final audit report. The final audit report shall be shared with Roche at the same time it is shared with Dicerna.

14.3 Over-or Underpayment

If the audit reveals an overpayment of royalties, Dicerna shall reimburse Roche for the amount of the overpayment within [* * *]. If the audit reveals an underpayment of royalties, Roche shall make up such underpayment of royalties within [* * *]. Roche shall pay for the audit costs if the underpayment

of Roche exceeds [* * *] of the aggregate amount of royalty payments owed with regard to the royalty statements subject of the audit. Section 12.2 shall apply to this Section 14.3.

15. Intellectual Property

15.1 Ownership of Inventions

All GalXC Platform Improvements shall be owned by Dicerna. Roche shall promptly notify Dicerna of any GalXC Platform Improvements invented by Roche solely or jointly with Dicerna. Roche hereby assigns and agrees to assign to Dicerna all right, title and interest in such GalXC Platform Improvements and to execute and deliver all documents, instruments and other papers and take all actions necessary to perfect such assignment and for Dicerna to Handle Patent Rights in such GalXC Platform Improvements.

All Roche Background Improvements shall be owned by Roche. Dicerna shall promptly notify Roche of Roche Background Improvements invented by Dicerna solely or jointly with Roche. Dicerna hereby assigns and agrees to assign to Roche all right, title and interest in such Roche Background Improvements and to execute and deliver all documents, instruments and other papers and take all actions necessary to perfect such assignment and for Roche to Handle Patent Rights in such Roche Background Improvements.

Other than GalXC Platform Improvements and Roche Background Improvements, Dicerna shall own all Dicerna Inventions, Roche shall own all Roche Inventions, and Dicerna and Roche shall jointly own all Joint Inventions. Dicerna and Roche each shall require all of its employees to assign all Inventions made by them to Roche and Dicerna, as the case may be.
The determination of inventorship for Inventions shall be in accordance with US inventorship laws as if such Inventions were made in the US.

Subject to the licenses granted under this Agreement, Dicerna and Roche will each have an equal undivided share in the Joint Patent Rights, without obligation to account to the other for exploitation thereof, or to seek consent of the other Party for the grant of any license thereunder.

Except as specifically set forth herein, this Agreement shall not be construed as: (i) giving any of the Parties any license, right, title, interest in or ownership to (a) the Confidential Information of the other Party or (b) any materials, Know-How, Patent Rights or other intellectual property rights Controlled by the other Party or its Affiliates; (ii) granting any license or right under any intellectual property rights; or (iii) representing any commitment by either Party to enter into any additional agreement, by implication or otherwise.

With respect to Know-How (other than patentable Inventions) made in connection with any activity carried out pursuant to this Agreement, Dicerna shall own such Know-How made by employees of Dicerna solely or jointly with a Third Party, Roche shall own such Know-How made by employees of the Roche Group solely or jointly with a Third Party, and the Parties shall jointly own Joint Know-How, subject to Section 2.6.1.

15.2 Trademarks

Roche shall own all trademarks used on or in connection with Products and shall, at its sole cost, be responsible for procurement, maintenance, enforcement and defense of all trademarks used on or in connection with Products, provided that if applicable Roche shall include in US Co-Promotion Product

labeling appropriate reference to Dicerna's company trademark(s). Roche shall not use any trademarks owned by Dicerna without Dicerna's prior written consent.

Roche shall have the right to obtain the International Non-proprietary Name (INN) from the World Health Organization and the US Adopted Name (USAN) from the US adopted Names Council (USANC) as the generic name(s) for the Products.

Dicerna shall use the Co-Promotion Product trademarks in accordance with Section 10.4, the Co-Promotion Agreement and sound trademark and trade name usage principles and in accordance with all Applicable Law as reasonably necessary to maintain the validity and enforceability of the Co-Promotion Product Trademarks. Dicerna recognizes that the Co-Promotion Product trademarks owned by Roche or Roche's Affiliates represent a valuable asset of Roche, and that substantial recognition and goodwill are associated with such name, logo and trademarks.

15.3 Prosecution

15.3.1 GalXC Platform Patent Rights

Dicerna shall be responsible for Handling, at its own expense and discretion, Dicerna GalXC Platform Patent Rights.

15.3.2 Specific Patent Rights

Roche shall, at its own expense and discretion: (i) Handle all Specific Patent Rights, (ii) consult with Dicerna as to the Handling of such Specific Patent Rights, and (iii) furnish to Dicerna copies of all documents relevant to any such Handling. Roche shall furnish such documents and consult with Dicerna in sufficient time before any action by Roche is due to allow Dicerna to provide comments thereon, which comments Roche must reasonably consider. At Roche's expense and reasonable request, Dicerna shall cooperate, in all reasonable ways, with the Handling of all such Specific Patent Rights. Should Roche decide that it wishes to abandon or does not desire to Handle a given Specific Patent Right, it shall promptly advise Dicerna thereof. At the written request of Dicerna, Dicerna may thereafter Handle the same at Dicerna's own cost, to the extent that Dicerna desires to do so. An outside law firm shall be used to Handle such Specific Patent Right; Roche and Dicerna shall consult and agree upon the law firm(s). Roche shall ensure that the Handling of such Specific Patent Rights are as protective of and uses a similar level of diligence that Roche would devote to similar Patent Rights Covering other similarly-situated products of Roche.

15.3.3 Other Patent Rights

For any Patent Rights other than the foregoing Patent Rights in Sections 15.3.1 and 15.3.2: (i) each party shall, at its own expense and discretion, Handle Patent Rights claiming Inventions that are owned solely by such Party or its Affiliates (alone or with a Third Party) at its own expense and discretion, and (ii) the Parties will jointly cooperate in the Handling of Joint Patent Rights.

15.4 Patent Coordination Team

Where the Parties need to consult with each other on the Handling of Patent Rights, the Parties shall establish a patent coordination team and shall adopt procedures for interacting on patent matters.

15.5 CREATE Act

It is the intention of the Parties that this Agreement is a "joint research agreement" as that phrase is defined in 35 USC §103(c)(3).

15.6 Infringement
Each Party shall promptly provide written notice to the other Party during the Agreement Term of any (i) known infringement or suspected infringement by a Third Party of any Licensed IP Patent Rights or Joint Patent Rights, or (ii) known or suspected unauthorized use or misappropriation by a Third Party of any Licensed IP Know-How or Joint Know-How, and shall provide the other Party with all evidence in its possession supporting such infringement or unauthorized use or misappropriation.

15.6.1 [* * *]
[* * *]

15.6.2 [* * *]
[* * *]

15.6.3 [* * *]
[* * *]

15.7 Defense
[* * *]

15.8 Hatch-Waxman
Notwithstanding anything herein to the contrary, should a Party receive a certification for a Generic Product pursuant to the Drug Price Competition and Patent Term Restoration Act of 1984 (Public Law 98-417, known as the Hatch-Waxman Act), as amended, or its equivalent in a country other than the US, then such Party shall immediately provide the other Party with a copy of such certification. Upon receipt of such a certification Roche shall (i) promptly seek to obtain a copy of the regulatory filing for such Generic Product (as contemplated in the Hatch-Waxman Act), (ii) promptly determine whether Roche will, within a [* * *] period from the date of such certification, bring suit at its expense, and provide written notice to Dicerna of such decision ("**H-W Suit Notice**"), and (iii) in any event provide Dicerna a H-W Suit Notice within [* * *] from the date on which Roche first received a copy of such certification. Should such [* * *] period expire without Roche bringing suit or providing such H-W Suit Notice, then Dicerna shall be free to immediately bring suit in its name.

15.9 Patent Term Extensions
The Parties shall use Commercially Reasonable Efforts to obtain all available patent term extensions, adjustments or restorations, or supplementary protection certificates ("**SPCs**", and together with patent term extensions, adjustments and restorations, "**Patent Term Extensions**") in the Territory. Dicerna shall execute such authorizations and other documents and take such other actions as may be reasonably requested by Roche to obtain such Patent Term Extensions for relevant Specific Patent Rights, including designating Roche as its agent for such purpose as provided in 35 USC § 156. All filings for such Patent Term Extensions shall be made by Roche; provided, that in the event that Roche elects not to file for a Patent Term Extension, Roche shall (a) promptly inform Dicerna of its intention not to file and (b) grant Dicerna the right to file for such Patent Term Extension. Each Party shall execute such authorizations and other documents and take such other actions as may be reasonably requested by the other Party to obtain such extensions. The Parties shall cooperate with each other in gaining patent term restorations, extensions and/or SPCs wherever applicable to such Dicerna

Patent Rights; provided, however, that notwithstanding anything to the contrary herein, Dicerna shall have the sole right to decide on Patent Term Extensions of the GalXC Platform Patent Rights.

15.10Costs of Patent Challenge

[* * *]

16. Representations, Warranties and Covenants

Each Party makes the following representations and warranties to the other Party as of the Signature Date or the Effective Date, as applicable, and covenants after the Effective Date.

16.1 Dicerna Representations, Warranties and Covenants

16.1.1 Data and Safety Information Disclosure

To the knowledge of Dicerna, it has disclosed to Roche: (i) the relevant and material results of all preclinical testing and human clinical testing of Products in its possession or control; and, (ii) the relevant and material information in its possession or control concerning side effects, injury, toxicity or sensitivity reaction and incidents or severity thereof with respect to Product. Dicerna and its Affiliates are, and at all times have been to its knowledge, in compliance with all adverse event reporting requirements applicable to the Lead Product. To Dicerna's knowledge, Dicerna has disclosed to Roche as of the Signature Date an accurate in all material aspects list of (i) adverse drug experience information (adverse events and lab abnormalities/cohort in the Dicerna Phase I Study, the severity of each, grading and outcomes), (ii) material events and matters concerning or affecting safety or lack of efficacy, and (iii) medical inquiries and complaints, in each case, relating to the Lead Product. Neither Dicerna nor any of its Affiliates is aware of anything that could materially adversely affect the acceptance, or the subsequent approval, of any Product by any Regulatory Authority of any filing, application or request for Regulatory Authority.

16.1.2 Regulatory Documentation and No Misrepresentations to Regulatory Authorities

Dicerna and its Affiliates have, to their knowledge, with respect to Lead Product, generated, prepared, maintained and retained all material regulatory documentation that is required to be maintained or retained pursuant to and in accordance with cGLPs and cGCPs and in compliance with Applicable Law, and to the best of their knowledge and ability all such information is true, complete, accurate in all material respects and what it purports to be. Neither Dicerna nor any of its Affiliates, nor any of its or their respective officers, employees or agents, to the best of their knowledge, has made an untrue statement of material fact or fraudulent statement to any Regulatory Authority with respect to the development or manufacture of the Lead Product, failed to disclose a material fact required to be disclosed to any Regulatory Authority with respect to the development or manufacture of the Lead Product, or committed an act, made a statement, or failed to make a statement with respect to the development or manufacture of the Lead Product that could reasonably be expected to provide a basis for the FDA to invoke its policy concerning "Fraud, Untrue Statements of Material Facts, Bribery, and Illegal Gratuities", set forth in 56 Fed. Reg. 46191 (September 10, 1991) and any amendments thereto or any analogous laws or policies in the Territory.

16.1.3 Third Party Patent Rights

As of the Signature Date, Dicerna has no knowledge of the existence of any patent or patent application owned by or licensed to any Third Party that could prevent Roche from making, having made, using, offering for sale, selling or importing Product in the Territory.

16.1.4 Ownership of Patent Rights

Dicerna is the exclusive owner of all right, title and interest in the Dicerna Base Patent Rights. Appendix 1.43 of this Agreement contains a complete and accurate list of all Patent Rights in the Dicerna GalXC Platform Patent Rights as of the Signature Date. No other parties have any right, title or interest in or to the Dicerna Base Patent Rights. Except for rights granted herein, the Dicerna Base Patent Rights are free and clear of all liens, claims, security interests and other encumbrances of any kind or nature for Viral Targets. Dicerna has not granted any licenses to the Dicerna Base Patent Rights to any Third Party, nor has Dicerna effectuated any prior transfer, sale or assignment of any part of the Dicerna Base Patent Rights, except to Affiliates.

16.1.5 Existing Third Party In-License Agreements

Except as set forth in Appendix 16.1.5 and permitted hereunder, there are no agreements between Dicerna and any of its Affiliates with any Third Parties (i) pursuant to which Dicerna or its Affiliates has obtained, or has a right to obtain, a license under or rights to use Dicerna Patent Rights in HBV or (ii) pursuant to which Dicerna or its Affiliates otherwise owes, or would otherwise owe, payments to a Third Party as a result of the exploitation of the Lead Compound and Lead Product based upon the Dicerna Patent Rights (whether by Dicerna or Roche or their respective sublicensees), including the grant of rights to Roche.

16.1.6 Inventors

The inventors of the inventions disclosed and/or claimed in the Licensed IP have transferred (or will have transferred for Licensed IP Patent Rights filed after the Signature Date) to Dicerna full ownership of the Licensed IP. All of Dicerna's employees, officers and consultants have executed agreements requiring assignment to Dicerna of all Inventions made by such individuals during the course of and as a result of their association with Dicerna.

16.1.7 Authorization

The execution, delivery and performance of this Agreement by Dicerna and all instruments and documents to be delivered by Dicerna hereunder, and assuming that no filing is required under the HSR Act: (i) are within the corporate power of Dicerna; (ii) have been duly authorized by all necessary or proper corporate action; (iii) to the knowledge of Dicerna, will not violate any law or regulation or any order or decree of any court of governmental instrumentality; (iv) will not violate the terms of any indenture, mortgage, deed of trust, lease, agreement, or other instrument to which Dicerna is a party or by which Dicerna or any of its property is bound, which violation would have an adverse effect on the financial condition of Dicerna or on the ability of Dicerna to perform its obligations hereunder; and (v) do not require any filing or registration with, or the consent or approval of, any governmental body, agency, authority or any other person, which has not been made or obtained previously (other than approvals required under the HSR Act, Regulatory Approvals required for the sale of Products and filings with Regulatory Authorities required in connection with Products).

16.1.8 No Conflict

Neither Dicerna nor any of its Affiliates is or will be under any obligation to any person, contractual or otherwise, that is conflicting with the terms of this Agreement or that would impede the fulfillment of Dicerna's obligations hereunder.

16.1.9 Target Exclusion

Dicerna has and will continue to ensure that its Third-Party agreements appropriately exclude licenses to compounds Directed To Viral Targets, until such compounds become available to Third Parties by early termination of such rights under this Agreement. Dicerna will ensure that its Third Party agreements entered into on or after a given Host Cell Factor Target becomes a Selected Target or Reserved Target appropriately exclude licenses to compounds Directed To such Host Cell Factor Target until either (i) after the R&D Collaboration Term, the target of such compounds are not Selected Targets or (ii) such compounds become available to Third Parties by early termination of such rights under this Agreement.

16.1.10 Validity of Patent Rights

As of the Signature Date, Dicerna is not in possession of information that could render invalid and/or unenforceable any claims that are in any of the Licensed IP. As of the Signature Date, Dicerna has no knowledge of any inventorship disputes concerning any Licensed IP.

16.1.11 Ownership and Validity of Know-How

Dicerna's Know-How is legitimately in the possession of Dicerna and has not been misappropriated from any Third Party. Dicerna has taken reasonable measures to protect the confidentiality of its Know-How.

16.1.12 Effective Date

During the period from the Signature Date until the Effective Date, Dicerna shall promptly inform Roche in writing if and when Dicerna or any of its Affiliates becomes aware that the representations and warranties made by Dicerna as of the Signature Date are no longer true and correct in any material respects if made on and as of the date of such notice, except where such failure to be true and correct would not have any material adverse effect on Roche. Upon receipt of such notice, Roche shall have the right, on written notice to Dicerna, to terminate the Agreement, and upon receipt of such notice by Dicerna, this Agreement shall be null and void and have no further force and effect.

16.2 Roche Representations, Warranties and Covenants

16.2.1 Authorization

The execution, delivery and performance of this Agreement by Roche and all instruments and documents to be delivered by Roche hereunder, and assuming that no filing is required under the HSR Act: (i) are within the corporate power of Roche; (ii) have been duly authorized by all necessary or proper corporate action; (iii) are not in contravention of any provision of the certificate of formation or limited liability company agreement of Roche; (iv) to the knowledge of Roche, will not violate any law or regulation or any order or decree of any court of governmental instrumentality; (v) will not violate the terms of any indenture, mortgage, deed of trust, lease, agreement, or other instrument to which Roche is a party or by which Roche or any of its property is bound, which violation would have an adverse effect on the financial condition of Roche or on the ability of Roche to perform its obligations hereunder; and (vi) do not require any filing or registration with, or the consent or approval of, any governmental body, agency, authority or any other person, which has not been made or obtained previously (other than approvals required under the HSR Act, Regulatory Approvals required for the sale of Products and filings with Regulatory Authorities required in connection with Products).

16.2.2 Inventors

All Roche employees and officers have executed agreements requiring assignment to Roche or Roche Affiliates of all Inventions made by such individuals. All consultants performing services by or on behalf of Roche under this Agreement shall have entered into agreements with Roche in accordance with Section 2.4.3.

16.2.3 No Conflict

Neither Roche nor any of its Affiliates is or will be under any obligation to any person, contractual or otherwise, that is conflicting with the terms of this Agreement or that would impede the fulfillment of Roche's obligations hereunder.

16.2.4 Regulatory Documentation and No Misrepresentations to Regulatory Authorities

Roche and its Affiliates shall, to their knowledge, with respect to Lead Product, generate, prepare, maintain and retain all material regulatory documentation that is required to be maintained or retained pursuant to and in accordance with cGLPs and cGCPs and in compliance with Applicable Law, and to the best of their knowledge and ability all such information shall be true, complete, accurate in all material respects and what it purports to be. Neither Roche nor any of its Affiliates, nor any of its or their respective officers, employees or agents, to the best of their knowledge, shall make an untrue statement of material fact or fraudulent statement to any Regulatory Authority with respect to the development or manufacture of the Lead Product, fail to disclose a material fact required to be disclosed to any Regulatory Authority with respect to the development or manufacture of the Lead Product, or commit an act, make a statement, or fail to make a statement with respect to the development or manufacture of the Lead Product that could reasonably be expected to provide a basis for the FDA to invoke its policy concerning "Fraud, Untrue Statements of Material Facts, Bribery, and Illegal Gratuities", set forth in 56 Fed. Reg. 46191 (September 10, 1991) and any amendments thereto or any analogous laws or policies in the Territory.

16.2.5 Ownership and Validity of Know-How

The Know-How that Roche contributes to the R&D Collaboration is legitimately in the possession of Roche and has not been misappropriated from any Third Party. Roche has taken reasonable measures to protect the confidentiality of such Know-How.

16.2.6 Effective Date

During the period from the Signature Date until the Effective Date, Roche shall promptly inform Dicerna in writing if and when Roche or any of its Affiliates becomes aware that the representations and warranties made by Roche as of the Signature Date are no longer true and correct in any material respects if made on and as of the date of such notice, except where such failure to be true and correct would not have any material adverse effect on Dicerna.

16.3 Mutual Representations and Warranties

Each Party hereby represents and warrants to the other Party as follows:

16.3.1 Grants

To the best of such Party's knowledge and belief, such Party has the lawful right to grant the other Party and its Affiliates the rights and licenses described in this Agreement.

16.3.2 No Claims

As of the Signature Date, there are no claims or investigations to such Party's knowledge, (other than with respect to the Parties' HSR filings), pending or threatened against such Party or any of its Affiliates,

at law or in equity, or before or by any governmental authority relating to the matters contemplated under this Agreement or that would materially adversely affect such Party's ability to perform its obligations hereunder.

16.4 No Other Representations and Warranties

EXCEPT AS OTHERWISE PROVIDED IN THIS AGREEMENT, THE FOREGOING REPRESENTATIONS AND WARRANTIES ARE IN LIEU OF ALL OTHER REPRESENTATIONS AND WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF PRODUCTS.

17. Indemnification

17.1 Indemnification by Roche

Roche shall indemnify, hold harmless and defend Dicerna, Dicerna's Affiliates and their directors, officers, employees and agents ("**Dicerna Indemnitees**") from and against any and all liabilities, losses, expenses, cost of defense (including reasonable attorneys' fees, witness fees, damages, judgments, fines and amounts paid in settlement) and any amounts Dicerna Indemnitees become legally obligated to pay because of the breach of the Agreement by Roche or any claim or claims against it to the extent that such claim or claims arise out of activities related to the Compounds or Products (e.g., product liability claims or Roche's R&D Collaboration activities or its Development or Commercialization of Compounds or Products) conducted by or on behalf of Roche, except to the extent such losses, expenses, costs and amounts are due to the breach of the Agreement by Dicerna or the gross negligence or willful misconduct or failure to act of Dicerna Indemnitees.

17.2 Indemnification by Dicerna

Dicerna shall indemnify, hold harmless and defend Roche, Roche's Affiliates and their directors, officers, employees and agents ("**Roche Indemnitees**") from and against any and all liabilities, losses, expenses, cost of defense (including reasonable attorneys' fees, witness fees, damages, judgments, fines and amounts paid in settlement) and any amounts Roche Indemnitees become legally obligated to pay because the breach of the Agreement by Dicerna or of any claim or claims against it to the extent that such claim or claims arise out of activities related to the Compounds or Products (e.g., product liability claims or Dicerna's R&D Collaboration activities or its Co-Promotion of Lead Products) conducted by or on behalf of Dicerna or its Affiliates, except to the extent such losses, expenses, costs and amounts are due to the breach of the Agreement by Roche or the gross negligence or willful misconduct or failure to act of Roche Indemnitees.

17.3 Procedure

In the event of a claim by a Third Party against a Party entitled to indemnification under this Agreement ("**Indemnified Party**"), the Indemnified Party shall promptly notify the other Party ("**Indemnifying Party**") in writing of the claim and the Indemnifying Party shall undertake and solely manage and control, at its sole expense, the defense of the claim and its settlement. The Indemnified Party shall cooperate with the Indemnifying Party and may, at its option and expense, be represented in any such action or proceeding by counsel of its choice. The Indemnifying Party shall not be liable for any litigation costs or expenses incurred by the Indemnified Party without the Indemnifying Party's written consent. The Indemnifying Party shall not settle any such claim unless such settlement fully and unconditionally releases the Indemnified Party from all liability relating thereto, unless the Indemnified Party otherwise agrees in writing.

18. Liability

18.1 Limitation of Liability

Subject to the Parties' obligations hereunder to use Commercially Reasonable Efforts including in Article 4 (Diligence), neither Party shall be liable to the other Party as a result of failure or delay to develop and/or commercialize the Compound or the Product, as applicable, including a) a delay in timelines, or b) delay or failure to recruit patients, or c) a change in its respective study protocols, or d) failure to obtain regulatory approval for the Compound or the Product, as applicable.

EXCEPT FOR EITHER PARTY'S INDEMNIFICATION OBLIGATIONS UNDER ARTICLE 17 OR BREACH OF ARTICLE 19, NEITHER PARTY SHALL BE ENTITLED TO RECOVER FROM THE OTHER PARTY ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES IN CONNECTION WITH THIS AGREEMENT OR ANY LICENSE GRANTED HEREUNDER.

19. Obligation Not to Disclose Confidential Information

19.1 Non-Use and Non-Disclosure

During the Agreement Term and for [* * *] thereafter, a Receiving Party shall (i) treat Confidential Information provided by Disclosing Party as it would treat its own information of a similar nature, (ii) take all reasonable precautions not to disclose such Confidential Information to Third Parties, without the Disclosing Party's prior written consent, and (iii) not use such Confidential Information other than for fulfilling its obligations and exercising its rights under this Agreement.

19.2 Permitted Disclosure

Notwithstanding the obligation of non-use and non-disclosure set forth in Section 19.1, the Parties recognize the need for certain exceptions to this obligation, specifically set forth below, with respect to press releases, patent rights, publications, securities law requirements, and certain commercial considerations.

19.3 Press Releases

The Parties may issue a press release announcing the existence and selected key terms of this Agreement, in a form substantially similar to the template attached as Appendix 18.3 of this Agreement.

Roche may issue press releases in accordance with its internal policy that typically does not issue a second press release until proof of concept has been achieved for a Compound. Roche shall provide Dicerna with a copy of any draft press release related to the activities contemplated by this Agreement at least [* * *] prior to its intended publication for Dicerna's review. Dicerna may provide Roche with suggested modifications to the draft press release. Roche shall in good faith consider Dicerna's suggestions prior to issuing its press release.

Dicerna shall only issue press releases related to the activities contemplated by this Agreement that either (i) have been approved by Roche or (ii) are required to be issued by Dicerna as a matter of law and Dicerna has been advised by counsel to that effect. In all circumstances, Dicerna shall endeavor to provide Roche with a draft press release at least [* * *] prior to its intended publication (or as soon as practicable with good faith) for Roche's review. During such period, Roche shall (i) approve the draft press release and permit Dicerna to issue the press release, (ii) contact Dicerna to discuss modification to the draft press release, or (iii) contact Dicerna and disapprove the press release. If Roche asks for modification, then Dicerna shall either make such modification or work with Roche to arrive at a press release that Roche approves. If Dicerna issues a press release without Roche's

approval, then such release must be made by Dicerna in consultation with counsel that the release was required to be issued by Dicerna as a matter of law.

To ensure communication alignment, responses (if any) to inquiries by media or other Third Parties after issuance of a permitted press release by Dicerna (solely or jointly with Roche) shall consist solely of the press release language or shall follow the response guidelines that may be mutually developed by the Parties (or as deemed necessary by Dicerna's counsel).

19.4 Publications

During the Agreement Term, the following restrictions shall apply with respect to disclosure by any Party of Confidential Information relating to the Product in any scientific publication or presentation (provided that, for avoidance of doubt, such restrictions shall not apply to information contained in patent applications):

(a) Both Parties acknowledge that it is their policy for studies and results thereof to be registered and published in accordance with their internal guidelines. Roche, in accordance with its internal policies and procedures, shall have the right to publish all studies, clinical trials and results thereof on the clinical trial registries that are maintained by or on behalf of Roche. Other than with respect to the Dicerna Phase I Study, Dicerna shall not publish any studies, clinical trials or results thereof on its clinical trial registry, provided however, that Roche's clinical trial registry can be accessed *via* a link from Dicerna's clinical trial registry.

(b) Dicerna may not publish such information about Licensed Products without the prior written consent of Roche.

19.5 Commercial Considerations

(a) Nothing in this Agreement shall prevent Dicerna or its Affiliates from disclosing Confidential Information of Roche to (i) Third Parties acting on behalf of Dicerna, to the extent reasonably necessary and as permitted for the development, manufacture or Co-Promotion of Lead Product in the Territory, (ii) Third Parties requesting Dicerna Phase I Study clinical trial data information (in accordance with Dicerna's then-current data sharing policy), or (iii) actual and potential partners and investors subject to commercially reasonable confidentiality obligations.

(b) Nothing in this Agreement shall prevent Roche or its Affiliates from disclosing Confidential Information of Dicerna to (i) governmental agencies to the extent required or desirable to secure government approval for the development, manufacture or sale of Product in the Territory, (ii) Third Parties acting on behalf of Roche, to the extent reasonably necessary for the development, manufacture or sale of Product in the Territory, (iii) Third Parties requesting clinical trial data information (in accordance with the applicable Party's then-current data sharing policy), (iv) Third Parties to the extent reasonably necessary to market the Product in the Territory, or (iv) actual and potential partners and investors subject to commercially reasonable confidentiality obligations.

(c) The Receiving Party may disclose Confidential Information of the Disclosing Party to the extent that such Confidential Information is required to be disclosed by the Receiving Party to comply with Applicable Law, to defend or prosecute litigation or to comply with governmental regulations, provided that the Receiving Party provides prior written notice of such disclosure to the Disclosing Party and, to the extent practicable, takes reasonable and lawful actions to minimize the degree of such disclosure.

(d) The Parties acknowledge that either or both Parties may be obligated to make one or more filings (including to file a copy of this Agreement) with the U.S. Securities and Exchange Commission

(or equivalent foreign agency) or a governmental authority. Each Party will be entitled to make such a required filing, provided that if such filing includes a copy of this Agreement it will (i) submit in connection with such filing a copy of this Agreement in a form mutually agreed by the Parties in advance or, if despite the reasonable efforts of Dicerna a form mutually agreed by the Parties cannot be agreed in advance, redacted to the extent permitted by Applicable Law (the "**Redacted Agreement**"), (ii) request, and use reasonable efforts consistent with Applicable Laws to obtain, confidential treatment of all terms redacted from this Agreement, as reflected in the Redacted Agreement, for a period of at least [* * *], (iii) to the extent consistent with Applicable Law, promptly deliver to the other Party any written correspondence received by it or its representatives from the U.S. Securities and Exchange Commission (or equivalent foreign agency) or a governmental authority with respect to such confidential treatment request and promptly advise the other Party of any other material communications between it or its representatives with the U.S. Securities and Exchange Commission (or equivalent foreign agency) or a governmental authority with respect to such confidential treatment request, (iv) upon the written request of the other Party, if legally justifiable, request an appropriate extension of the term of the confidential treatment period, and (v) if the U.S. Securities and Exchange Commission (or equivalent foreign agency) or a governmental authority requests any changes to the redactions set forth in the Redacted Agreement, use reasonable efforts consistent with Applicable Laws to maintain the redactions in the Redacted Agreement as originally filed and not agree to any changes to the Redacted Agreement without, to the extent practical, first discussing such changes with the other Party and taking the other Party's comments into consideration when deciding whether to agree to such changes (provided that a Party will only be required to make such efforts to support such redactions once). For clarity, following a request from a governmental authority to change the redactions requested by a Party, a Party will not be required pursuant to the provisions of this Section 19.5(d) to again request the redactions rejected by the applicable governmental authority. Each Party will be responsible for its own legal and other external costs in connection with any such filing, registration or notification.

19.6 Injunctive Relief

The Parties agree that a breach of Article 19 may cause irrevocable harm for which monetary damages might not provide a sufficient remedy. In case of an actual or threatened material breach of Article 19, in addition to any other remedy available under this Agreement or under applicable Laws or equity, the non-breaching Party will be entitled to seek and obtain equitable relief (including temporary or permanent restraining orders, specific performance or other injunctive relief) from any court of competent jurisdiction, without the necessity of posting any bond or of any undertaking (other than with respect to enjoining a product launch), and without any requirement to submit to any dispute resolution procedures contained herein.

20. Term and Termination

20.1 Commencement and Term

This Agreement shall commence upon the Effective Date and continue for the Agreement Term.

20.2 Termination

20.2.1 Termination for Material Breach

After the Effective Date, a Party ("**Non-Breaching Party**") shall have the right to terminate this Agreement in its entirety or on a Product-by-Product basis in the event the other Party ("**Breaching**

Party") is in material breach (which shall include any breach of Section 3.9 (Exclusivity), Section 4 (Diligence) and Section 22.17 (Compliance with Laws)) of its obligations under this Agreement. The non-Breaching Party shall provide written notice to the Breaching Party, which notice shall identify the material breach. The Breaching Party shall have a period of [* * *] after such written notice is provided ("**Peremptory Notice Period**") to cure such material breach. If the Breaching Party has a dispute as to whether such material breach occurred or has been cured, it will so notify the Non-Breaching Party within the Peremptory Notice Period and the Agreement shall not terminate until such dispute is resolved pursuant to Section 22.2 and 22.3. Upon a determination of material breach and failure to cure, the Breaching Party shall have the Peremptory Notice Period to cure such material breach. If such material breach is not cured within the Peremptory Notice Period, then absent withdrawal of the Non-Breaching Party's request for termination, this Agreement shall terminate in its entirety or with respect to such Product effective as of the expiration of the Peremptory Notice Period.

20.2.2 Insolvency

Either Party shall have the right to terminate this Agreement, if the other Party incurs an Insolvency Event; provided, however, in the case of any involuntary bankruptcy proceeding, such right to terminate shall only become effective if the Party that incurs the Insolvency Event consents to the involuntary bankruptcy or such proceeding is not dismissed within [* * *] after the filing thereof.

20.2.3 Effects of Change of Control

If there is a Change of Control, then the Party experiencing such Change of Control ("**Acquired Party**") shall provide written notice to the other Party ("**Non-Acquired Party**") at least [* * *] prior to completion of such Change of Control, subject to any confidentiality obligations of the Acquired Party then in effect (but in any event shall notify the Non-Acquired Party within [* * *] after completion of such Change of Control).

The Change of Control Group in connection with such Change of Control shall not have the right to utilize any of the Non-Acquired Party's Know-How (excluding information generally applicable to other products or retained in the unaided memory of Dicerna employees), Patent Rights, Inventions, Materials or Confidential Information (collectively, "**Sensitive Information**") for the research, development or commercialization of any product for the treatment of any indication or patient population for which a Product may be developed or commercialized.

Following consummation of the Change of Control, the Non-Acquired Party and the Change of Control Group shall adopt in writing reasonable procedures to prevent the disclosure of Sensitive Information beyond the Acquired Party's personnel who need to know the Sensitive Information solely for the purpose of fulfilling the Acquired Party's obligations under this Agreement or for lawful reporting obligations. [* * *].

20.2.4 Termination by Roche without a Cause

After the Effective Date, Roche shall have the right to terminate a given Research Plan under the R&D Collaboration (i.e. on a Selected Target-by-Selected Target basis) or the R&D Collaboration in its entirety upon [* * *] prior written notice, and such Selected Target shall become a Discontinued Target.

In addition to the foregoing, at any time after the Effective Date, Roche shall have the right to terminate this Agreement as a whole or on a Licensed Product-by-Licensed Product basis upon [* * *] prior written notice before First Commercial Sale of a Licensed Product or upon [* * *] prior written notice after the First Commercial Sale of a Licensed Product. The effective date of termination under this Section 20.2.4

paragraph 2 shall be the date [* * *] as the case may be) after Roche provides such written notice to Dicerna.

20.2.5 Termination of Selected Targets

After the Effective Date, at the end of the R&D Collaboration Term (or earlier termination thereof), if across all Selected Targets Roche does not select any Additional Dicerna Compounds as a Clinical Candidate, Roche shall have the right, but not the obligation, to terminate all rights to all Additional Dicerna Compounds generated under the R&D Collaboration upon [* * *] written notice. After a Clinical Candidate is selected for a given Selected Target or after the Target Term if Roche provides a Roche Continuation Notice, Roche shall have the right to (or where required by Section 3.8, the obligation to) terminate with respect to all Licensed Products for such Selected Target upon [* * *] prior written notice. Upon such termination, such Selected Target shall become a Discontinued Target.

20.2.6 Termination for Patent Challenge

[* * *].

20.3 Consequences of Termination

20.3.1 Roche Compound License

In the event of a (i) termination of the Agreement as a whole by Roche pursuant to Section 20.2.1 (for Material Breach by Dicerna), Section 20.2.2 (for Dicerna's Insolvency) or Section 20.2.4 (Without a Cause) or (ii) termination pursuant to Section 20.2.5 (Termination of Selected Targets) or pursuant to Section 20.2.6 (for Patent Challenge) (a "**Non-Exclusive Trigger**") then

(a) Roche shall retain the Non-Exclusive Roche License for (i) all applicable Roche Compounds (for Agreement termination) or (ii) all applicable Roche Compounds Directed To the given Selected Target being terminated (for Selected Target termination),

(b) Article 4 notwithstanding, Roche shall not continue to have diligence obligations related to any such Roche Compounds, and,

(c) the financial compensation owed to Dicerna for Roche Compounds under Sections 11.2.2 and 11.4.2.2 and shall remain, but subject to the following reductions:

(i) [* * *]

(ii) [* * *]

(iii) [* * *].

[* * *].

Notwithstanding the foregoing, if Roche terminates the R&D Collaboration in its entirety on or before Initiation of the first Phase II Study for the Lead Product, the financial compensation owed to Dicerna for Roche Compounds shall be eliminated in its entirety.

(collectively, the "**Non-Exclusive Conditions**").

20.3.2 Termination by Dicerna pursuant to Section 20.2.1 (Material Breach by Roche) or Section 20.2.2 (Insolvency)

Upon any termination by Dicerna pursuant to Section 20.2.1 (Material Breach by Roche) or Section 20.2.2 (Insolvency) all rights and licenses granted by Dicerna to Roche under this Agreement shall terminate in their entirety or on a Product-by-Product basis, as applicable, on the effective date of termination. If the alleged material breach by Roche is of its obligations under Article 4, then termination shall only be on a Product-by-Product basis.

If Dicerna desires to continue Development and/or Commercialization of Licensed Product(s), Dicerna shall give a Continuation Election Notice to Roche within [* * *] of Dicerna's notice of such termination. If Roche receives such a timely Continuation Election Notice, then with respect to applicable Licensed Product(s) and to the extent reasonably requested by Dicerna:

(a) Roche hereby grants to Dicerna [* * *] license to Roche Grant-Back Patent Rights and (if such Licensed Product has achieved First Commercial Sale) the applicable Product Trademarks (in each case with the right to sublicense through multiple tiers), and a [* * *] license to Roche Know-How, solely to the extent necessary [* * *].

(b) After the effective date of termination Roche shall (or shall cause such other Roche Group member to), to the extent Roche has the right to do so, assign and transfer to Dicerna all regulatory filings and approvals, all final pre-clinical and clinical study reports and clinical study protocols, and all data, including clinical data, in Roche's possession and control related to applicable Licensed Product(s) in the country reasonably necessary for Dicerna to continue to Develop and Commercialize the Licensed Product(s). To the extent Roche does not have the right to make such assignment and/or transfer, Roche shall, to the extent possible, provide a license, right of reference, or other right or access to such regulatory filings and approvals, pre-clinical and clinical study reports and protocols, and data. All data shall be transferred in the form and format in which it is maintained by Roche. Original paper copies shall only be transferred, if legally required. Roche shall not be required to prepare or finalize any new data, reports or information solely for purposes of transfer to Dicerna.

(c) Roche shall assign all clinical trial agreements for applicable Licensed Product(s), to the extent such agreements have not been cancelled in good faith and are assignable without Roche breaching such agreement (any required consideration to be paid by Roche). In any event, Roche shall cooperate and make all reasonable efforts to provide an orderly transition of clinical activities and continue such agreements to support such transition.

(d) Dicerna shall, upon transfer, have the right to disclose such filings, approvals and data to (i) governmental agencies of the country to the extent required or desirable to secure government approval for the development, manufacture or sale of Licensed Product(s) in the country, (ii) Third Parties acting on behalf of Dicerna, its Affiliates or licensees, to the extent reasonably necessary for the development, manufacture, or sale of Licensed Product(s) in the country, and (iii) Third Parties to the extent reasonably necessary to market Licensed Product(s) in the country.

(e) In consideration for the above license and transfers, and Roche's work on applicable Licensed Product(s), Dicerna shall pay Roche a royalty on all net sales (as determined by reasonable accounting methods) of Licensed Product(s) by Dicerna, its Affiliates or licensees, *mutatis mutandis*, with the royalty rate as follows:

Status of Product at termination effective date	Royalty rate for Lead Product	Royalty rate for other Licensed Products
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]

Notwithstanding the foregoing, Dicerna shall pay a [* * *] royalty on net sales for Licensed Products (other than with the Lead Product) that are Combination Products and where Roche has at least Completed a Phase I Study if Roche elects to not provide transfer and license access to the other therapeutically active ingredients contained in such Combination Product.

20.3.3 Termination by Roche without Cause or for Material Breach by Dicerna or Dicerna's Insolvency, or Termination for Patent Challenge

Subject to the Non-Exclusive Conditions, upon any termination by Roche without cause (under Section 20.2.4 or Section 20.2.5), for Dicerna's Insolvency, for material breach by Dicerna or for Patent Challenge (under Section 20.2.6), the rights and licenses granted by Dicerna to Roche under this Agreement shall terminate in their entirety or with respect to the R&D Collaboration or all Dicerna Compounds, or on a Licensed Product-by-Licensed Product, Selected Target-by-Selected Target or Research Plan-by-Research Plan basis, as applicable, on the effective date of termination.

If Dicerna desires to continue Development and/or Commercialization of Licensed Product(s), Dicerna shall give a Continuation Election Notice to Roche within [* * *] of receipt of Roche's notice of termination without cause. If Roche receives such a timely Continuation Election Notice, then with respect to applicable Licensed Product(s) and to the extent reasonably requested by Dicerna:

(a) Roche hereby grants to Dicerna an exclusive, royalty-bearing, worldwide license to Roche Grant-Back Patent Rights and (if such Licensed Product has achieved First Commercial Sale) the applicable Product Trademarks (in each case with the right to sublicense through multiple tiers), and a non-exclusive, royalty-free, worldwide license to Roche Know-How, solely to the extent reasonably necessary to allow Dicerna, its Affiliates or licensees to develop, have developed, manufacture, have manufactured, use, offer to sell, sell, promote, export and import the applicable Licensed Product(s) in the applicable country(ies). For clarity, the licenses under this Section 20.3.3(a) shall not include any licenses that Roche has with a Third Party for which such grant would be prohibited or under which a member of the Roche Group would incur financial obligations to such Third Party.

(b) After the effective date of termination Roche shall, to the extent Roche has the right to do so, assign and transfer to Dicerna all regulatory filings and approvals, all final pre-clinical and clinical study reports and clinical study protocols, and all data, including clinical data, in Roche's possession and control related to applicable Licensed Product(s) in the country reasonably necessary for Dicerna to continue to Develop and Commercialize the Licensed Product(s). To the extent Roche does not have the right to make such assignment and/or transfer, Roche shall, to the extent possible, provide a license, right of reference, or other right or access to such regulatory filings and approvals, pre-clinical and clinical study reports and protocols, and data. All data shall be transferred in the form and format in which it is maintained by Roche. Original paper copies shall only be transferred, if legally required. Roche shall not be required to prepare or finalize any new data, reports or information solely for purposes of transfer to Dicerna.

(c) Roche shall assign all clinical trial agreements for the applicable Licensed Product(s), to the extent such agreements have not been cancelled in good faith and are assignable without Roche paying any consideration or commencing litigation in order to effect an assignment of any such agreement, provided that Roche has agreed to such consideration in good faith and has given Dicerna notice of the requisite amount of consideration and affording Dicerna the opportunity to provide such consideration. In any event, Roche shall cooperate and make all reasonable efforts to provide an orderly transition of clinical activities and continue such agreements to support such transition.

(d) Dicerna shall, upon transfer, have the right to disclose such filings, approvals and data to (i) governmental agencies of the country to the extent required or desirable to secure government approval for the development, manufacture or sale of Licensed Product(s) in the country; (ii) Third Parties acting on behalf of Dicerna, its Affiliates or licensees, to the extent reasonably necessary for the development, manufacture, or sale of Licensed Product(s) in the country, and (iii) Third Parties to the extent reasonably necessary to market Licensed Product(s) in the country.

(e) In consideration for the above license and transfers, and Roche's work on applicable Licensed Product(s), Dicerna shall pay Roche a royalty on all net sales (as determined by reasonable accounting methods) of Licensed Product(s) by Dicerna, its Affiliates or licensees, *mutatis mutandis*, with the royalty rate as follows:

Status of Product at termination effective date	**Royalty rate for Lead Product**	**Royalty rate for other Licensed Products**
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]

Notwithstanding anything to the contrary herein, if Roche terminates an individual Selected Target without replacing it with another under the procedures set forth in Section 3.6, then all Additional Dicerna Compounds related to such Selected Target shall revert to Dicerna free of charge.

20.3.4 Direct License

Irrespective of anything to the contrary in this Agreement,

(a) any Compulsory Sublicense shall remain in full force and effect as may be required by Applicable Law, and

(b) any existing sublicense granted by Roche (and any further sublicenses thereunder) in accordance with Section 2.4.2 shall, upon the written request of Roche, remain in full force and effect, provided that (i) such Sublicensee is not then in breach of its sublicense agreement (and, in the case of termination by Dicerna for breach by Roche, that such Sublicensee and any further sublicensees did not cause the breach that gave rise to the termination by Dicerna); (ii) Dicerna continues to receive the amounts for development and regulatory event payments and sales based events as set forth in Sections 11.2 and 11.3; (iii) the royalty rates in such sublicense agreement are equal to the royalty rates set forth in Section 11.4 and are received by Dicerna; and (iv) such Sublicensee agrees in writing to be bound to Dicerna under the terms and conditions of such sublicense agreement and the applicable terms of this Agreement.

20.3.5 Other Obligations

20.3.5.1 Obligations Related to Ongoing Activities

If Dicerna does not provide timely Continuation Election Notice, then Roche (a) shall have the right to cancel all ongoing non-financial obligations with respect to the applicable Licensed Product(s) and (b) shall complete all non-cancellable obligations at its own expense.

If Dicerna provides such timely Continuation Election Notice, then from the date of notice of termination until the effective date of termination, Roche shall continue activities for the applicable Licensed Product(s), including preparatory activities, ongoing as of the date of notice of termination. Additionally, for Third Party CMO and CRO service providers in use by Roche for the applicable Licensed Product(s) of Roche, upon request of Dicerna Roche will facilitate an introduction to, cooperate in good faith, and allow Dicerna to contract directly with, such contractual party, if possible. Roche shall not be obliged to initiate any new activities not ongoing at the date of notice of termination.

After the effective date of termination, Roche shall have no obligation to perform and/or complete any activities or to make any payments for performing or completing any Development activities under this Agreement, except as expressly stated in the Agreement. Roche shall promptly transfer back to Dicerna all patent prosecution files relating to Licensed IP and patent prosecution activities to Dicerna's control.

Notwithstanding the foregoing, in case of termination by Dicerna under Section 20.2.1 or 20.2.2 or by Roche under Section 20.2.4, upon the request of Dicerna, Roche shall complete any Clinical Studies related to the applicable Licensed Product(s) that are being conducted under its CTAs for the Licensed Product(s) and are ongoing as of the effective date of termination; provided, however, that:

(i) both Dicerna and Roche in their reasonable judgment have concluded that completing any such Clinical Studies does not present an unreasonable risk to patient safety;

(ii) Roche shall have no obligation to recruit or enroll any additional patients after the date of termination; and

(iii) Dicerna shall be responsible for all Development Costs that arise after the effective date of termination in completing such Clinical Studies.

Either Party shall have the right to complete on-going pre-clinical animal studies if the early termination thereof would raise potential ethical concerns concerning animal rights issues.

20.3.5.2 Obligations Related to Manufacturing

(a) Clinical Supplies
In the case of termination by Dicerna according to Section 20.2.1 or 20.2.2 or by Roche under Section 20.2.4, if Dicerna elects to Develop the applicable Licensed Product(s), Roche shall transfer all existing and available clinical material to Dicerna at Roche's fully burdened manufacturing cost. Dicerna shall assume all liability for the use of such material.

(b) Commercial Supplies
In the case of termination by Dicerna according to Section 20.2.1 or 20.2.2 or by Roche under Section 20.2.4, if a Licensed Product is marketed in any country of Territory on the date of the notice of termination of this Agreement, upon the request of Dicerna, Roche shall manufacture and supply reasonable amounts of such Licensed Product to Dicerna under a manufacturing transfer and transition plan for a period that shall not exceed [* * *] from the effective date of the termination of this Agreement at a price to be agreed by the Parties in good faith, but in no event

exceeding (i) Roche's fully burdened manufacturing cost, if the Licensed Product is manufactured tor Roche through a Third Party contract, or (ii) Roche's fully burdened manufacturing cost plus a mark-up of [* * *], if Roche manufactures the Licensed Product itself, as calculated on a consistent basis according to its then current accounting procedures. Dicerna shall use Commercially Reasonable Efforts to take over such manufacturing as soon as possible after the effective date of termination. If, despite using Commercially Reasonable Efforts, Dicerna has not secured commercial supply of the Product within the [* * *] period, then the Parties shall use Commercially Reasonable Efforts to ensure an uninterrupted commercial supply for up to a maximum additional [* * *] period, in quantities sufficient to satisfy Dicerna's requirements and for Dicerna to assume all development and commercialization activities, at a price which shall be at (i) Roche's fully burdened manufacturing cost plus a mark-up of [* * *] if Product is manufactured for Roche through a Third Party contract, or (ii) Roche's fully burdened manufacturing cost plus a mark-up of [* * *] if Roche manufactures Product itself, under terms to be negotiated in good faith.

20.3.5.3 Ancillary Agreements

Unless otherwise agreed by the Parties, the termination of this Agreement shall cause the automatic termination of all ancillary agreements related hereto, including the Pharmacovigilance Agreement and the Co-Promotion Agreement, if any.

20.3.5.4 Limitations on Grant-Backs; Transfer Expenses; Damages and Other Relief

For purposes of clarity, irrespective of anything to the contrary in this Agreement:

(a) Dicerna may not give a Continuation Election Notice to Roche for Licensed Products (other than the Lead Product) that have not advanced into Development by or on behalf of Roche as of the effective date of termination.

(b) All transfers and licenses from Roche to Dicerna (or other obligations of Roche) under Section 20.3 are solely (i) where the Licensed Product contains both the Lead Compound and a Selected Target Compound, only with respect to the applicable Dicerna Compound(s) that have been previously terminated or are subject to the termination, (ii) with respect to Licensed Product(s) that are not (A) Combination Product(s) containing a compound that is proprietary to Roche or subject to Third Party rights or (B) Companion Diagnostics, and (iii) for the applicable Licensed Product that is being Developed or Commercialized by or on behalf of Roche as it exists on the effective date of termination. Such transfers, licenses and obligations do not extend to other therapeutically active ingredients or products, even if physically mixed, combined or packaged together with a Licensed Product, and even if a Licensed Product is intended (according to the investigation plan, proposed labeling or actual labeling, as applicable) for use with such other therapeutically active ingredients or products.

(c) In connection with research studies, clinical trials or other activities associated with the Development and Commercialization of Licensed Products, Roche may have collected (i) personally identifiable information about individual human subjects and/or (ii) human biological samples (collectively, "**PII/Samples**"). Legal and contractual restrictions may apply to such PII/Samples. Roche shall have no obligation to transfer such PII/Samples unless reasonably necessary or useful for the continued Development of the Licensed Product, in which case Roche shall not be obliged to transfer any PII/Samples that Roche in good faith believes would be prohibited or would subject Roche to potential liability by reason of Applicable Law, insufficient patient consent or contractual restrictions (however for contractual restrictions, upon request of Dicerna Roche

will facilitate an introduction to the applicable contractual party and allow Dicerna to contract directly with such contractual party, if possible). If Roche transfers any such PII/Samples, Dicerna shall use for the sole purpose of Developing and Commercializing the Licensed Product, and Dicerna shall be responsible for the correct use of the PII/Samples in line with Applicable Law and the informed consent forms (including but not limited to potential re-consenting of the patients at Dicerna's costs).

(d) Dicerna shall promptly reimburse Roche for all reasonable out-of-pocket costs and expenses (including FTE charges) incurred by or on behalf of Roche for transfer activities from Roche to Dicerna under Sections 20.3.2 and 20.3.3 ("**Roche Transfer Activities**"); however transfer activities corresponding to the return of materials, data, reports, records, documents, Regulatory Filings and Regulatory Approvals originally provided by Dicerna to Roche no less than [* * *] from the effective date of termination ("**Dicerna-Originated Transfer Activities**") shall be returned to Dicerna (if readily available) free of charge. If Dicerna desires Roche Transfer Activities other than Dicerna-Originated Transfer Activities, Dicerna shall make a payment to Roche of [* * *] ("**Minimum Transfer Payment**"). The Minimum Transfer Payment shall be non-refundable, but shall be fully creditable against Dicerna's reimbursement for the Roche Transfer Activities. Roche shall be under no obligation to provide Roche Transfer Activities (beyond than Dicerna-Originated Transfer Activities) prior to receipt of the Minimum Transfer Payment or if the Minimum Transfer Payment is received after the effective date of the termination.

(e) Unless otherwise agreed to by the Parties, transfer of physical materials that are required under Roche Transfer Activities (except in conjunction with such future toll manufacturing obligations as may apply under Section (b), if applicable) shall be delivered CPT Dicerna or Dicerna's designee to the location designated by Dicerna (Incoterms 2010).

(f) Neither Party may use any documents or materials provided by the other Party as part of any license or transfer under this Section 20.3 as evidence in any legal proceedings against the providing Party, however this exception will not apply to documents or materials exchanged pursuant to discovery requests or other litigation processes.

(g) Termination of this Agreement and exercise of the rights and remedies set forth herein (or failure to terminate or exercise such rights and remedies) shall not preclude either Party from claiming any other damages, compensation or relief to which it may be entitled.

20.3.5.5 Royalty and Payment Obligations; Return of Information and Technology

Termination of this Agreement by a Party, for any reason, shall not release Roche from any obligation to pay royalties or make any payments to Dicerna that accrued prior to the effective date of termination. Termination of this Agreement by a Party, for any reason, will release Roche from any obligation to pay royalties or make any payments to Dicerna that would otherwise accrue on or after the effective date of termination. To the extent practicable, upon expiration or termination of this Agreement, each Party shall return to the other Party, or destroy, the other Party's Confidential Information and all copies thereof, except to the extent and for so long as such Confidential Information is included within the scope of any surviving license, and provided that each Party may keep [* * *] copy of the other Party's Confidential Information in its confidential files solely for records purposes. Without limiting the foregoing, upon termination of this Agreement or a Product is returned to Dicerna, Roche shall return to Dicerna the information and materials solely with respect to such Licensed Product which shall become Dicerna's Confidential Information.

20.4 Survival

Article 1 (Definitions, to the extent necessary to interpret this Agreement), Section 2.3 (Non-Exclusive Roche License), Section 2.4.2 (last sentence of first paragraph), Section 2.4.3 (Right to Subcontract, for purpose of continuing obligations under Article 20), Section 2.6 (Freedom-to-operate Licenses), Section 3.5.2 (Research Records, for purpose of continuing obligations under Article 20), Articles 11 and 12 (Payment to Dicerna, and Accounting and Reporting, each to the extent payment obligations exist at the time of termination), Article 13 (Taxes, to the extent such were incurred at the time of termination), Article 14 (Auditing, for [* * *], Section 15.1 (Ownership of Inventions), Sections 15.6, 15.7, and 15.8 (Infringement, Defense, and Hatch-Waxman, for purpose of accrued obligations), Section 15.10 (Costs of Patent Challenge), Section 16.4 (No Other Representations and Warranties), Article 17 (Indemnification), Article 18 (Liability), Article 19 (Obligation Not to Disclose Confidential Information), Article 20 (Term and Termination), Article 21 (Bankruptcy), and Article 22 (Miscellaneous, but excluding Sections 22.4, 22.6, 22.17 and 22.18), and such sections as are relevant for the *mutatis mutandis* provisions under Sections 20.3.2(e) and 20.3.3(e) shall survive any expiration or termination of this Agreement for any reason.

21. Bankruptcy

All licenses (and to the extent applicable rights) granted under or pursuant to this Agreement are, and shall otherwise be deemed to be, for purposes of Section 365(n) of Title 11, US Code (the "**Bankruptcy Code**") licenses of rights to "intellectual property" as defined under Section 101(35A) of the Bankruptcy Code. Unless a Party elects to terminate this Agreement, the Parties agree that such Party, as a licensee or sublicensee of such rights under this Agreement, shall retain and may fully exercise all of its rights and elections under the Bankruptcy Code, subject to the continued performance of its obligations under this Agreement.

22. Miscellaneous

22.1 Governing Law; Excluded Claims

This Agreement shall be governed by and construed in accordance with the laws of the US state of Delaware, without reference to its conflict of laws principles.

Notwithstanding anything to the contrary in this Agreement, Excluded Claims shall be determined in a court of competent jurisdiction over such Excluded Claim. With respect to Excluded Claims, each Party consents to the jurisdiction of the state and federal courts located in the State of New York and waives any objection to such courts on grounds of personal jurisdiction, venue, or forum non conveniens.

22.2 Disputes

Unless otherwise set forth in this Agreement, in the event of any dispute between the Parties arising out of or relating to this Agreement (each, a "**Dispute**") and the Parties cannot resolve such Dispute (through their respective Alliance Directors or the JRC or JSC, if and as applicable) within [* * *] of a written request by either Party to the other Party ("**Notice of Dispute**"), and such Dispute is not one for which a Party has final decision-making as expressly set forth in this Agreement, such Dispute shall be referred to the respective executive officers of the Parties designated below or their designees, for good faith negotiations attempting to resolve the Dispute. The designated executive officers are as follows:

For Dicerna: CEO
For Roche: Head of Pharma Partnering

22.3 Arbitration

Except for an Excluded Claim, should the Parties fail to resolve a Dispute within [* * *] after delivery of a Notice of Dispute, then such Dispute shall be finally resolved by binding arbitration by [* * *] arbitrators experienced in the business of pharmaceuticals in accordance with the commercial arbitration rules of the International Chamber of Commerce (ICC) as in force at the time when initiating the arbitration applying the substantive law specified in Section 22.1. The right and obligation to arbitrate under this Section 22.3 shall extend to any claims by or against the Parties and their respective Affiliates and any agents, principals, officers, directors or employees of either of the Parties or their respective Affiliates.

Each Party shall nominate one arbitrator. Should the claimant fail to appoint an arbitrator in the request for arbitration within [* * *] of being requested to do so, or if the respondent should fail to appoint an arbitrator in its answer to the request for arbitration within [* * *] of being requested to do so, the other Party shall request the ICC Court to make such appointment.

The arbitrators nominated by the Parties shall, within [* * *] from the appointment of the arbitrator nominated in the answer to the request for arbitration, and after consultation with the Parties, agree and appoint a third arbitrator, who will act as a chairman of the Arbitral Tribunal. Should such procedure not result in an appointment within the [* * *] time limit, either Party shall be free to request the ICC Court to appoint the third arbitrator.

Where there is more than one claimant and/or more than one respondent, the multiple claimants or respondents shall jointly appoint one arbitrator.

If any Party-appointed arbitrator or the third arbitrator resigns or ceases to be able to act, a replacement shall be appointed in accordance with the arrangements provided for in this Section.

The place of arbitration shall be [* * *]. The language to be used shall be English.

Either Party, without waiving any remedy under this Agreement, may seek from any court having jurisdiction any temporary injunctive or provisional relief necessary to protect the rights or property of that Party. Once the arbitrators are in place, either Party may also apply to the arbitrators for interim injunctive relief until the arbitration award is rendered or the controversy is otherwise resolved, and either Party may apply to a court of competent jurisdiction to enforce interim injunctive relief granted by the arbitrators. Any final award by the arbitrators may be entered by either Party in any court having appropriate jurisdiction for a judicial recognition of the decision and applicable orders of enforcement. The arbitrators may render early or summary disposition of any or some issues after the Parties have had a reasonable opportunity to make submissions on such issues. The arbitrators shall have no authority to award punitive or any other type of damages not measured by a Party's compensatory damages. Each Party shall bear its own costs and expenses and attorneys' fees and an equal share of the arbitrators' fees and any administrative fees of arbitration, unless the arbitrators determine otherwise.

Except to the extent necessary to confirm an award or as may be required by law, neither a Party nor an arbitrator may disclose the existence, content, or results of an arbitration without the prior written consent of both Parties. In no event shall an arbitration be initiated after the date when commencement

of a legal or equitable proceeding based on the dispute, controversy or claim would be barred by the applicable [* * *] statute of limitations.

22.4 HSR

As soon as is reasonably practicable following the Signature Date and in any event within [* * *] of the Signature Date, each of Dicerna (or its Affiliate, as appropriate) and Roche (or its Affiliate, as appropriate) shall prepare and submit appropriate filings under the United States Hart-Scott-Rodino Antitrust Improvements Act of 1976, as amended (the "**HSR Act**") and the rules promulgated thereunder, and request early termination of the waiting period under the HSR Act. The Parties shall furnish, or cause their respective Affiliates to furnish, as the case may be, promptly to the United States Federal Trade Commission (the "**FTC**") and the Antitrust Division of the United States Department of Justice (the "**DOJ**") any additional information reasonably requested within their authority under the HSR Act, use reasonable efforts to obtain antitrust clearance for the transactions contemplated hereunder as soon as practicable, and otherwise cooperate with each other in the United States governmental antitrust clearance process. Subject to Applicable Law relating to the exchange of information, each of Roche and Dicerna shall consult and cooperate with one another, and consider in good faith the views of one another, in connection with any analyses, appearances, presentations, memoranda, briefs, arguments, opinions and proposals made or submitted by or on behalf of any Party hereto in connection with proceedings under or relating to the HSR Act. Roche and Dicerna shall cooperate fully with each other in connection with the making of all such filings or responses. Each Party shall bear its own fees in connection with its respective filing under this Section 22.4 and each Party shall bear their respective attorneys' fees in connection therewith. This Agreement shall bind the Parties upon execution and continue in full force and effect unless and until the termination or expiration of the Agreement by its terms; provided, however, that this Agreement (including Dicerna's grant of license rights hereunder, Roche's obligation to make the payments hereunder, and each Party's performance of discovery, research, transfer development, communications with regulatory authorities and other activities, and other rights and obligations hereunder in connection with the Compounds and Products), other than this Section 22.4, shall not become effective or binding unless and until each of the following conditions are met: (i) the waiting period provided by the HSR Act shall have expired or been terminated, (ii) no court or administrative challenges to the transactions commenced by the FTC or DOJ are pending, and (iii) no court or administrative orders commenced by the FTC or DOJ are outstanding blocking the completion of the transactions, (the date of such, the "**Effective Date**"). Nothing in this Agreement shall require or be deemed to require either Party (or their Affiliates) to commit to any divestitures or licenses or agree to hold separate any assets or agree to any similar arrangements or commit to conduct its business in a specified manner, or to submit and respond to a formal discovery procedure initiated by the FTC or DOJ (i.e., a "Request for Additional Information and Documentary Materials" also known as a "second request", or Civil Investigative Demand if a filing is not required under the HSR Act), in each case as a condition to obtaining antitrust clearance for the transactions contemplated hereunder. If antitrust clearance is not received on or before [* * *] after the date on which both Parties have submitted to the FTC and DOJ their respective initial filings to request antitrust clearance of the transactions hereunder, then either Party shall have the right to terminate this Agreement, but prior to receipt of antitrust clearance of the transactions contemplated hereunder, by written notice to the other Party.

22.5 Assignment

Neither Party shall have the right to assign the present Agreement or any part thereof to any Third Party (other than Affiliates) without the prior written approval of the other Party; provided that, either Party may, without the prior written approval of the other Party, assign this Agreement and its rights and obligations hereunder (or under a transaction under which this Agreement is assumed) to the

acquirer of or successor to such Party in connection with a Change of Control (and shall so assign in connection with a sale of all or substantially all of the assets of such Party as further described in Section 20.2.3).

22.6 Debarment

Each Party represents and warrants that neither it nor its employees have been debarred under 21 U.S.C. §335a, disqualified under 21 C.F.R. §312.70 or §812.119, sanctioned by a Federal Health Care Program (as defined in 42 U.S.C §1320 a-7b(f)), including the federal Medicare or a state Medicaid program, or debarred, suspended, excluded or otherwise declared ineligible from any other similar Federal or state agency or program ("**Debarred**"). In the event a Party or an employee of such Party receives notice of debarment, suspension, sanction, exclusion, ineligibility or disqualification under the above-referenced statutes, such Party shall immediately notify the other Party in writing. Each Party and its Affiliates will not knowingly allow any Debarred employee to conduct activities under this Agreement.

22.7 Independent Contractor

No employee or representative of either Party shall have any authority to bind or obligate the other Party to this Agreement for any sum or in any manner whatsoever or to create or impose any contractual or other liability on the other Party without said Party's prior written approval. For all purposes, and notwithstanding any other provision of this Agreement to the contrary, each Party's legal relationship to the other Party under this Agreement shall be that of independent contractor, and nothing contained in this Agreement shall be deemed or construed to create a partnership, joint venture, employment, franchise, agency or fiduciary relationship between the Parties.

22.8 Unenforceable Provisions and Severability

If any of the provisions of this Agreement are held to be void or unenforceable, then such void or unenforceable provisions shall be replaced by valid and enforceable provisions that will achieve as far as possible the economic business intentions of the Parties, however the remainder of this Agreement will remain in full force and effect, provided that the material interests of the Parties are not affected, i.e. the Parties would presumably have concluded this Agreement without the unenforceable provisions.

22.9 Waiver

The failure by either Party to require strict performance and/or observance of any obligation, term, provision or condition under this Agreement will neither constitute a waiver thereof nor affect in any way the right of the respective Party to require such performance and/or observance. The waiver by either Party of a breach of any obligation, term, provision or condition hereunder shall not constitute a waiver of any subsequent breach thereof or of any other obligation, term, provision or condition.

22.10 Interpretation

Except where the context expressly requires otherwise:

(a) the use of any gender herein shall be deemed to encompass references to either or both genders, and the use of the singular shall be deemed to include the plural (and *vice versa*),

(b) the words "include", "includes" and "including" shall be deemed to be followed by the phrase "without limitation",

(c) any definition of or reference to any agreement, instrument or other document herein shall be construed as referring to such agreement, instrument or other document as from time to time

amended, supplemented or otherwise modified (subject to any restrictions on such amendments, supplements or modifications set forth herein),

(d) any reference herein to any Party or Third Party or person shall be construed to include the Party's or Third Party's or person's permitted successors and assigns,

(e) the words "herein", "hereof" and "hereunder", and words of similar import, shall be construed to refer to this Agreement in its entirety and not to any particular provision hereof,

(f) all references herein to Articles, Sections or Appendices shall be construed to refer to Articles, Sections or Appendices of this Agreement, and references to this Agreement include all Appendices hereto,

(g) references to any specific law, rule or regulation, or article, section or other division thereof, shall be deemed to include the then-current amendments thereto or any replacement or successor law, rule or regulation thereof, and

(h) the term "or" shall be interpreted in the inclusive sense commonly associated with the term "and/or".

22.11Entire Understanding

This Agreement contains the entire agreement and understanding between the Parties hereto with respect to the within subject matter and supersedes any and all prior agreements, understandings and arrangements, whether written or oral, and all other communications between the Parties with respect to such subject matter. In case of inconsistencies between this Agreement and any Appendix hereof, the terms of this Agreement shall prevail unless agreed to explicitly that the Appendix should prevail. This Agreement shall be binding upon and inure to the benefit of the Parties and their respective legal representatives, successors and permitted assigns. The Parties acknowledge and agree that, as of the Effective Date, all Confidential Information disclosed pursuant to the CDA by a Party or its Affiliates shall be included in the Confidential Information subject to this Agreement and the Confidentiality Agreement is hereby superseded in its entirety; provided, that the foregoing shall not relieve any Person of any right or obligation accruing under the Confidentiality Agreement prior to the Effective Date. "**CDA**" means the Non-Disclosure Agreement between Dicerna and Roche US dated February 5, 2019.

22.12Amendments

No amendments of or modifications to the terms and conditions of this Agreement shall be binding upon either Party hereto unless in writing and signed by both Parties.

22.13Invoices

22.13.1Invoices to Roche

All invoices for payments to Dicerna that are required or permitted hereunder shall be in writing (or via email if directed by Roche) and sent by Dicerna to Roche at the following address or such other address (including email) as Roche may later provide:

F. Hoffmann-La Roche Ltd
Kreditorenbuchhaltung
Grenzacherstrasse 124
4070 Basel
Switzerland
Attn: (name of a Roche Alliance Director at the time)

22.13.2Invoices to Dicerna

All invoices for payments to Roche that are required or permitted hereunder shall be in writing and sent by Roche to Dicerna via e-mail to the following addresses or such other address as Dicerna may later provide:

Accounts Payable: [* * *]
David Miller: [* * *]

22.14Notice

All notices that are required or permitted hereunder shall be in writing and sufficient if delivered personally, sent by facsimile (and promptly confirmed by personal delivery, registered or certified mail or overnight courier), sent by nationally recognized overnight courier or sent by registered or certified mail, postage prepaid, return receipt requested, addressed as follows:

if to Dicerna, to:	Dicerna Pharmaceuticals, Inc. 33 Hayden Avenue Lexington, MA 02421 U.S.A. Attn: Dicerna CEO
and:	Dicerna Pharmaceuticals, Inc. 33 Hayden Avenue Lexington, MA 02421 U.S.A. Attn: Dicerna Legal Department Email: [* * *]
if to Roche, to:	F. Hoffmann-La Roche Ltd Grenzacherstrasse 124 4070 Basel Switzerland Attn: Legal Department
and:	Hoffmann-La Roche Inc. 150 Clove Road Suite 8 Little Falls, New Jersey 07424 U.S.A. Attn. Corporate Secretary

or to such other address as the Party to whom notice is to be given may have furnished to the other Party in writing in accordance herewith.

22.15Force Majeure

Neither Party shall be responsible to the other for any failure or delay in performing any of its obligations under this Agreement or for other nonperformance hereunder (excluding, in each case, the obligation to make payments when due) if such delay or nonperformance is caused by strike, fire, flood, earthquake, accident, war, act of terrorism, act of God or of the government of any country or of any local government, or by any other cause unavoidable or beyond the control of any Party hereto. In such event, such affected Party shall use Commercially Reasonable Efforts to resume performance of its obligations and will keep the other Party informed of actions related thereto.

22.16Further Assurances
Roche and Dicerna hereby covenant and agree without the necessity of any further consideration, to execute, acknowledge and deliver any and all documents and take any action as may be reasonably necessary to carry out the intent and purposes of this Agreement.

22.17Compliance with Laws
Each Party shall, or shall cause its Affiliates, sublicensees or Third Party contractors to, perform its obligations under this Agreement in accordance with all Applicable Laws, including (i) all applicable local, state, federal and national data security and privacy laws, rules and implementing regulations, including the Health Insurance Portability and Accountability Act (HIPAA) and General Data Protection Regulation (2016/679), (ii) all applicable laws relating to anti-corruption, anti-kickbacks and anti-money laundering, including U.S. Foreign Corrupt Practices Act of 1977 and the UK Bribery Act of 2010, (iii) any GCPs, cGLPs, GMPs or GRPs (iv) Internal Compliance Codes, as applicable and (v) applicable securities laws. No Party shall, or shall be required to, undertake any activity under or in connection with this Agreement which violates, or which it believes, in good faith, may violate, any Applicable Laws.

22.18Export
Laws and regulations of the United States may restrict the export and re-export of commodities and technical data of United States origin. Neither Party shall export or re-export restricted commodities or the technical data of the other Party in any form without appropriate United States and foreign government licenses.

22.19No Third Party Beneficiary Rights
This Agreement is not intended to and shall not be construed to give any Third Party any interest or rights (including any Third Party beneficiary rights) with respect to or in connection with any agreement or provision contained herein or contemplated hereby, except as otherwise expressly provided for in this Agreement.

22.20Counterparts; Electronic Signatures
This Agreement may be executed in one or more counterparts, each of which will be deemed an original, and all of which together will be deemed to be one and the same instrument.

[Signature Page Follows]

IN WITNESS WHEREOF, the Parties have entered into this Agreement as of the Effective Date.

Dicerna Pharmaceuticals, Inc.

___/s/ Douglas Fambrough_____
Name: Douglas Fambrough
Title: CEO

F. Hoffmann-La Roche Ltd

____/s/ Vikes Kabra_____
Name: Vikes Kabra
Title: Head of Transaction Excellence

_____/s/ Stefan Arnold_____
Name: Stefan Arnold
Title: Head of Legal Pharma

Hoffmann-La Roche Inc.

_____/s/ John P. Parise_____
Name: John. P Parise
Title: Authorized Signatory

Appendix 1.41

Dicerna Base Patent Rights

[* * *]

Appendix 1.43

Dicerna GalXC Platform Patent Rights
as of the Effective Date

Priority Applications	Title	National Applications
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]

[* * *]

Priority Applications	Title	National Applications
[* * *]	[* * *]	[* * *]

Appendix 1.91

[* * *]

Appendix 2.4.2

[* * *]

Appendix 10.6.3

[* * *]

Appendix 16.1.5

Existing Third Party In-License Agreement

[* * *]

Appendix 19.3

Form of Press Release

Dicerna Enters Agreement with Roche to Develop and Commercialize DCR-HBVS for the Treatment of Chronic Hepatitis B Virus (HBV) Infection

– Roche to gain worldwide license to Dicerna's novel RNAi therapy currently in Phase 1 –
– Dicerna to receive $200 million upfront plus up to $1.47 billion in potential milestone payments related to DCR-HBVS –
– Dicerna to retain option to co-fund pivotal development of DCR-HBVS worldwide and co-promote in U.S. with enhanced royalties –
– Collaboration includes discovery and development of additional therapies targeting multiple additional gene targets implicated in chronic HBV infection –

CAMBRIDGE, Mass., November 1, 2019 – Dicerna™ Pharmaceuticals, Inc. (Nasdaq: DRNA) today announced a research collaboration and licensing agreement with Roche (SIX: RO, ROG; OTCQX: RHHBY) to develop novel therapies for the treatment of chronic hepatitis B virus (HBV) infection using Dicerna's proprietary GalXC™ RNAi platform technology. The collaboration will focus on worldwide development and commercialization of DCR-HBVS, Dicerna's investigational therapy in Phase 1 clinical development. The collaboration also includes the discovery and development of therapies targeting multiple additional human and viral genes associated with HBV infection using the technology platforms of both companies.

"Dicerna is excited to collaborate with Roche to realize the full potential of DCR-HBVS and leverage our GalXC platform to target and silence specific genes that contribute to chronic hepatitis B virus infection," said Douglas M. Fambrough, Ph.D., president and chief executive officer of Dicerna. "With its deep expertise in HBV and established global infrastructure, Roche is ideally suited to help us accelerate the development and commercialization of DCR-HBVS, pursue a cure for chronic HBV infection, and address this serious global threat to public health."

"We are excited to engage in a clinical partnership and research collaboration with Dicerna," said John Young, global head of Infectious Diseases at Roche Pharma Early Research & Development. "This partnership builds upon our existing portfolio and internal expertise and positions us well to develop a best-in-disease therapy to cure chronic HBV infection."

Under the terms of the agreement, Dicerna will receive $200 million in an initial upfront payment and may be eligible to receive up to an additional $1.47 billion over time for the achievement of specified development, regulatory and commercial milestones. In addition, Dicerna may be eligible to receive royalties based on potential product sales of DCR-HBVS. Dicerna retains an option to co-fund pivotal development of DCR-HBVS worldwide, which if exercised, entitles Dicerna to receive enhanced royalties and co-promote products including DCR-HBVS in the U.S.

Dicerna and Roche also agreed to collaborate on the research and development of additional therapies targeting multiple human and viral genes implicated in chronic HBV infection, using technology from both companies, for which Dicerna is eligible to receive additional milestones and royalties on any potential products.

The transaction is subject to the expiration or termination of the waiting period under the Hart-Scott-Rodino Antitrust Improvements Act of 1976 and other customary conditions.

About Chronic Hepatitis B Virus (HBV) Infection

Hepatitis B virus (HBV) is the world's most common serious liver infection, with more than 292 million patients chronically infected, according to the World Health Organization. Chronic HBV infection, a condition characterized by the presence of the HBV surface antigen (HBsAg) for six months or more, claims more than 800,000 lives annually. HBV is also the primary cause of liver cancer (also known as hepatocellular carcinoma or HCC), which is the second-leading cause of cancer deaths in the world.[1]

About DCR-HBVS and the DCR-HBVS-101 Clinical Trial

DCR-HBVS is an investigational drug in development for the treatment of chronic hepatitis B virus (HBV) infection. Current therapies for HBV, such as nucleoside analogs, can provide long-term viral suppression if taken continuously, but they rarely lead to long-term functional cures, as measured by the clearance of HBV surface antigen (HBsAg) and sustained HBV deoxyribonucleic acid (DNA) suppression in patient plasma or blood. By contrast, DCR-HBVS employs RNA interference to selectively knock down specific genes involved in the creation of HBV messenger RNA (mRNA) and the entry of the virus into liver cells. This approach leads to greater than 99.9% reduction in circulating HBsAg, as observed in mouse models of HBV infection. These data suggest that DCR-HBVS may induce clearance of HBsAg and contribute meaningfully to a functional cure for HBV.

Dicerna is conducting a Phase 1, randomized, placebo-controlled study designed to evaluate the safety and tolerability of DCR-HBVS in healthy volunteers (HVs) and in patients with non-cirrhotic chronic HBV infection.

About Dicerna's GalXC™ RNAi Technology Platform

Dicerna's proprietary RNA interference (RNAi) technology platform, called GalXC™, aims to advance the development of next-generation RNAi-based therapies designed to silence disease-driving genes in the liver and other body systems. Liver-targeted GalXC-based compounds enable subcutaneous delivery of RNAi therapies that are designed to specifically bind to receptors on liver cells, leading to internalization and access to the RNAi machinery within the cells. The GalXC approach seeks to optimize the activity of the RNAi pathway so that it operates in the most specific and potent fashion. Compounds produced via GalXC are intended to be broadly applicable across multiple therapeutic areas, including both liver and non-liver indications.

About Dicerna™ Pharmaceuticals, Inc.

Dicerna™ Pharmaceuticals, Inc., is a biopharmaceutical company using ribonucleic acid (RNA) interference (RNAi) to develop medicines that silence genes that cause disease. The Company's proprietary GalXC™ technology is being applied to develop potent, selective, and safe RNAi therapies for treatment of rare diseases, chronic liver diseases, cardiovascular diseases, neurodegenerative diseases, pain, and viral infectious disease. Dicerna aims to treat disease by addressing the underlying causes of illness with capabilities that extend beyond the liver to address a broad range of diseases, focusing on target genes where connections between gene and disease are well understood and documented. Dicerna intends to discover, develop, and commercialize novel therapies either on its own or in collaboration with pharmaceutical partners. Dicerna has strategic collaborations with Roche, Eli Lilly and Company (Lilly), Alexion Pharmaceuticals, Inc. (Alexion), and Boehringer Ingelheim International GmbH (BI). For more information, please visit www.dicerna.com.

Dicerna Forward-Looking Statement

This press release includes forward-looking statements. Such forward-looking statements are subject to risks and uncertainties that could cause actual results to differ materially from those expressed or implied in such statements. Examples of forward-looking statements include, among others, statements we make regarding: (i) the full potential of DCR-HBVS and to leverage our GalXC platform to target and silence specific genes that contribute to HBV cures; (ii) the potential to earn revenue from royalties and milestone payments under the collaboration with Roche; (ii) research and development plans related to GalXC and its utility in silencing genes that contribute to HBV; (iii) the potential of RNAi therapies for the treatment of chronic HBV infection; and (iv) the potential for the collaboration between Roche and Dicerna. The process by which an early-stage platform such as GalXC could potentially lead to an approved

product is long and subject to highly significant risks, particularly with respect to a preclinical research collaboration. Applicable risks and uncertainties include those relating to preclinical research and other risks identified under the heading "Risk Factors" included in Dicerna's most recent Form 10-Q filings and in other future filings with the Securities and Exchange Commission. The forward-looking statements contained in this press release reflect Dicerna's current views with respect to future events, and Dicerna does not undertake and specifically disclaims any obligation to update any forward-looking statements, except as required by law.

Dicerna™ and GalXC™ are trademarks of Dicerna Pharmaceuticals, Inc.

Reference

1. Hepatitis B Foundation. Facts and Figures. 2019. Available at: http://www.hepb.org/what-is-hepatitis-b/what-is-hepb/facts-and-figures/. Accessed on October 25, 2019.

Contacts

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Lauren.stival@sternir.com

Media:
SmithSolve
Alex Van Rees, 973-442-1555 ext. 111
alex.vanrees@smithsolve.com

Exhibit 10.47

CERTAIN INFORMATION IDENTIFIED BY BRACKETED ASTERISKS ([* * *]) HAS BEEN OMITTED FROM THIS EXHIBIT BECAUSE IT IS BOTH NOT MATERIAL AND WOULD BE COMPETITIVELY HARMFUL IF PUBLICLY DISCLOSED.

COLLABORATION AND LICENSE AGREEMENT

between

NOVO NORDISK A/S

and

DICERNA PHARMACEUTICALS, INC.

NOVEMBER 15, 2019

List of Exhibits:

COLLABORATION AND LICENSE AGREEMENT

THIS COLLABORATION AND LICENSE AGREEMENT (the "**Agreement**"), entered into as of November 15, 2019 (the "**Signing Date**") is by and between **NOVO NORDISK A/S**, a corporation organized and existing under the laws of Denmark, having an address at Novo Allé, 2880 Bagsvaerd, Denmark, CVR No. 24 25 67 90 ("**Novo**"), on the one hand, and **DICERNA PHARMACEUTICALS, INC.**, a corporation organized and existing under the laws of Delaware, with its principal place of business at 33 Hayden Avenue, Lexington, Massachusetts 02421, U.S.A. ("**Dicerna**"), on the other hand. Dicerna and Novo are each referred to individually as a "**Party**" and together as the "**Parties**".

BACKGROUND

A. Novo is a leading global health care company engaged in the research, development and commercialization of pharmaceutical products.

B. Dicerna has developed a RNAi platform technology targeting hepatocytes in the liver using GalXC Molecules (as defined below) to silence mRNA molecules, which may lead to therapeutic uses of such GalXC Molecules in patients with unmet medical needs.

C. Novo and Dicerna desire to enter into this Agreement to allow the Parties to collaborate using Dicerna's GalXC Platform in selecting hepatocyte gene targets and identifying GalXC Molecules from which one or more Products could be developed to treat liver-associated cardiometabolic diseases, including non-alcoholic steatohepatitis, and potentially other diseases in each case, on terms set forth in this Agreement.

D. Novo desires to obtain exclusive and nonexclusive licenses from Dicerna to support the activities conducted pursuant to the research and development program and to enable Novo to Commercialize Products derived from or containing compounds developed pursuant to this Agreement, and Dicerna is willing to grant such rights to Novo subject to the terms and conditions as set forth below.

E. The Parties desire to jointly participate in the Development and Commercialization of certain Products.

F. Concurrently with the entering into of this Agreement, Dicerna and Novo are entering into a Share Issuance Agreement, pursuant to which Novo will purchase certain shares of Dicerna's Common Stock on the terms and conditions set forth therein.

NOW THEREFORE, in consideration of the mutual covenants and agreements contained herein, the sufficiency which is acknowledged by both Parties, the Parties agree as follows:

1. DEFINITIONS AND INTERPRETATIONS

Capitalized terms used in this Agreement shall have the meanings specified in this Article 1, or as defined elsewhere in this Agreement.

1.1 "**Acceptance for Filing**" means, following the submission of an application for Marketing Authorization made to a Regulatory Authority, the expiration of any applicable waiting period during which the Regulatory Authority has authority to issue a refusal to file, if any, as to such application.

1.2 "**Accounting Firm**" has the meaning set forth in Section 9.5.1.

1.3 "**Accounting Standards**" means accounting determinations made according to (i) U.S. Generally Accepted Accounting Principles, with respect to Dicerna and its Affiliates, and (ii) International Financial Reporting Standards, with respect to Novo and its Affiliates.

1.4 "**Acquirer**" has the meaning set forth in Section 1.24.

1.5 "**Act**" means, as applicable, the United States Federal Food, Drug, and Cosmetic Act, 44 U.S.C. §§ 301 *et seq*., or the Public Health Service Act, 42 U.S.C. §§ 262 *et seq*., as such may be amended from time to time.

1.6 "**Action**" has the meaning set forth in Section 10.7.5.

1.7 "**Affiliate**" means, with respect to a Party, a person, corporation, company, partnership, joint venture or other entity, which Controls, is Controlled by, or is under common Control with such Party. For the purpose of this definition, "Control" of an entity means the ownership, directly or indirectly, of more than fifty percent (50%) of the outstanding voting securities or capital stock of such entity, or the legal power to direct or cause the direction of the general management and policies of the entity in question. An entity will be deemed to be an Affiliate for so long as such Control exists. Novo Holdings A/S, the Novo Nordisk Foundation, and Novozymes A/S and their respective Excluded Affiliates (other than Novo and its subsidiaries) are not considered Affiliates of Novo. "Excluded Affiliates" means with respect to Novo Holdings A/S, the Novo Nordisk Foundation, and Novozymes A/S and any person, corporation, company, partnership, joint venture or other entity, which Controls, is Controlled by, or is under common Control with such entities.

1.8 "**Alexion**" has the meaning set forth in Section 1.18.

1.9 "**Alexion Agreement**" has the meaning set forth in Section 1.18.

1.10 "**Alliance Leader**" has the meaning set forth in Section 6.3.

1.11 "**Annual Net Sales**" means, on a Product-by-Product basis, for a given Calendar Year, all Net Sales of such Product throughout the Territory during such Calendar Year.

1.12 "**Applicable Laws**" means all federal, state, local, national and supra-national laws, statutes, rules and regulations, including any rules, regulations, guidelines or requirements of Regulatory Authorities, taxing authorities, national securities exchanges or securities listing organizations that may be in effect from time to time during the Term and applicable to a particular activity hereunder.

1.13 "**Audited Party**" has the meaning set forth in Section 9.5.1.

1.14 "**Auditing Party**" has the meaning set forth in Section 9.5.1.

1.15 "**BI**" has the meaning set forth in Section 1.18.

1.16 "**BI Agreement**" means that certain Collaborative Research and License Agreement between BI and Dicerna dated October 27, 2017, as (subject to Section 2.5) amended and in effect from time to time.

1.17 "**Bioinformatics Package and Mapping Plan**" has the meaning set forth in Section 8.1.2.

1.18 "**Blocked Target**" means targets [* * *].

1.19 "**Blocked Target List**" has the meaning set forth in Section 2.4.2.

1.20 "**Business Day**" means a day on which commercial banking institutions are open for business in each of Boston, Massachusetts, New York, New York, U.S. and Copenhagen, Denmark.

1.21 "**Calendar Day**" means any day of the Calendar Year.

1.22 "**Calendar Quarter**" means any respective period of three (3) consecutive calendar months ending on March 31, June 30, September 30 and December 31 of any Calendar Year.

1.23 "**Calendar Year**" means each successive period of twelve (12) months commencing on January 1 and ending on December 31.

1.24 "**Change of Control**" means:

(a) with respect to either Party: (i) the acquisition by a Third Party or group of Third Parties acting in concert, in one transaction or a series of related transactions, of direct or indirect beneficial ownership of more than fifty percent (50%) of the outstanding voting equity securities of such Party; (ii) a merger, transfer of control or consolidation involving such Party, as a result of which a Third Party or group of Third Parties acting in concert acquires direct or indirect beneficial ownership of more than fifty percent (50%) of the voting power of the surviving entity immediately after such merger, reorganization or consolidation; or (iii) a sale, transfer or disposition of all or substantially all of the assets of such Party in one transaction or a series of related transactions to a Third Party or group of Third Parties acting in concert, but in any event, excluding any consolidation or merger

effected exclusively to change the domicile of a Party where the ultimate indirect share ownership of the Party as a result of such consolidation or merger does not change. The acquiring or combining Third Party in any of (i), (ii) or (iii), and any of such Third Party's Affiliates (other than the acquired Party and its Affiliates as in existence prior to the applicable transaction) are referred to collectively herein as the "**Acquirer**"; or

(b) with respect to Dicerna: (i) the acquisition by a Novo Competitor (and/or Affiliates of such Novo Competitor) or group of Third Parties (of which at least one is a Novo Competitor) acting in concert, whether in one transaction or a series of related transactions, of: (1) majority control of the board of directors or equivalent governing body of Dicerna; (2) direct or indirect beneficial ownership of more than forty percent (40%) of the outstanding voting equity securities of Dicerna; or (ii) a merger, transfer of control or consolidation involving Dicerna, as a result of which a Novo Competitor (and/or Affiliates of such Novo Competitor) or group of Third Parties (of which at least one is a Novo Competitor) acting in concert acquires direct or indirect beneficial ownership of more than forty percent (40%) of the voting power of the surviving entity immediately after such merger, reorganization or consolidation; or (iii) a sale, transfer or disposition of all or substantially all of the assets of Dicerna related to the transactions contemplated by this Agreement. In any such case, such Novo Competitor and its Affiliates (other than Dicerna and its Affiliates in existence prior to the applicable transaction) shall also be considered an Acquirer of Dicerna.

1.25 "**Claims**" has the meaning set forth in Section 17.1.

1.26 "**Clinical Trial**" means a Phase 1 Clinical Trial, Phase 2 Clinical Trial or Phase 3 Clinical Trial, or any post-approval human clinical trial, as applicable.

1.27 "**CMC Activities**" means chemistry, manufacturing and controls activities.

1.28 "**CMC Working Group**" has the meaning set forth in Section 6.4.

1.1 "**Co-Development Budget**" has the meaning set forth in Section 5.4.1.

1.2 "**Co-Development Percentage**" means a percentage representing a designating Party's economic stake in a Co-Development Program. Novo as the designating Party under Section 3.3 will designate the percentage of at least [* * *] and not greater than [* * *] as X percent (X%) and Dicerna will be [* * *] minus X percent ([* * *]-X%). Dicerna as the designating Party under Sections 2.3.2(c) or 2.3.3 will designate the percentage of at [* * *] and not greater than [* * *] as X percent (X%) and Novo will be [* * *] minus X percent ([* * *]-X%).

1.3 "**Co-Development Post-Option Expenses**" means, with respect to a given Co-Development Program, the Co-Development Percentage multiplied by the portion of Development Expenses incurred after designation as a Co-Development Program.

1.4 "**Co-Development Pre-Option Expenses**" means with respect to a given Co-Development Program, the Co-Development Percentage multiplied by the portion of Development Expenses incurred [* * *] until designation as a Co-Development Program.

1.5 "**Co-Development Product**" means a Compound Directed To a Co-Development Target.

1.6 "**Co-Development Profit Share**" has the meaning set forth in Section 5.4.2.

1.7 "**Co-Development Program**" means Research of a Co-Development Target, or Development and Commercialization of a Co-Development Product.

1.8 "**Co-Development Target**" means a Target that either Dicerna or Novo has designated under Sections 2.3.2, 2.3.3, or 3.3 for co-development and co-commercialization.

1.9 "**Code**" has the meaning set forth in Section 15.5.

1.10 "**Collaboration Targets**" has the meaning set forth in Section 2.1.1, including Validated, Continuation and Co-Development Targets, but not Discontinued Targets.

1.11 "**Combination Product**" has the meaning set forth in Section 1.142.

1.12 "**Commercial Milestone Event**" has the meaning set forth in Section 8.5.

1.13 "**Commercial Milestone Payment**" has the meaning set forth in Section 8.5.

1.14 "**Commercialization**" or "**Commercialize**" means any and all activities directed to the offering for sale and sale of a Compound, Product, or other compound, product or therapy including: (a) activities directed to storing, marketing, promoting, detailing, distributing, importing, exporting, selling and offering to sell that Compound, Product, or other compound, product or therapy; (b) conducting Clinical Trials after Marketing Authorization of a Compound, Product, or other compound, product or therapy with respect to such Compound, Product, or other compound, product or therapy; (c) interacting with Regulatory Authorities regarding the foregoing; and (d) seeking pricing approvals and reimbursement approvals (as applicable) for that Compound, Product or other compound, product or therapy in the Field in the Territory. When used as a verb, "to **Commercialize**" and "**Commercializing**" means to engage in Commercialization and "**Commercialized**" has a corresponding meaning. For clarity, "**Commercialization**" shall not include any Research or Development activities.

1.15 "**Commercially Reasonable Efforts**" [* * *].

1.16 "**Competing GalXC Product**" means any product that contains a GalXC Molecule Directed To a Collaboration Target that is being researched, developed, used, made (including formulated) or commercialized by a Third Party.

1.17 "**Complement Pathway**" [* * *].

1.18 "**Compound**" [* * *].

1.19 "**Confidential Information**" means all Know-How or other information or materials of a Party, in any form (written, oral, electronic, photographic, or otherwise) that is confidential or proprietary, including:

(a) all Know-How which is generated by or on behalf of a Party under this Agreement or which one Party or any of its Affiliates or representatives has provided or otherwise made available to the other Party, including such Know-How comprising or relating to concepts, discoveries, Inventions, data, designs or formulae arising from this Agreement;

(b) all such information or materials regarding or concerning any Collaboration Target, Compound, Product, or any other technical or business information;

(c) all communications between the Parties or information of whatever kind whether recorded or not and, if recorded, in whatever medium, relating to or arising out of this Agreement, whether disclosed prior to or after entering into this Agreement;

(d) any information that the Party indicates in writing is information of a confidential nature or which is marked "confidential"; and,

(e) all copies and excerpts of the communications, information, notes, reports and documents in whatever form referred to in subclauses (a) through (d) of this definition.

For purposes of the confidentiality obligations set forth herein and subject to Section 7.6 and for so long as they continue as Confidential Information under Article 11: (i) Know-How owned or Controlled by Novo (other than Joint Know-How) shall be deemed Confidential Information of Novo; (ii) Know-How owned or Controlled by Dicerna (other than Joint Know-How) shall be deemed Confidential Information of Dicerna; (iii) the terms and conditions of this Agreement shall be deemed Confidential Information of both Parties; (iv) any disclosed information which is not publicly available relating to the Blocked Targets and is not otherwise possessed by Novo (and does not otherwise come into Novo's possession), including the identity of Dicerna Excluded Programs, or Discontinued Targets shall be deemed Confidential Information of Dicerna; (v) any of Novo's Confidential Information on Novo's Own Targets prior to selection of such Novo's Own Targets as Collaboration Targets shall continue to be Confidential Information of Novo even after such Novo's Own Targets become Discontinued Targets; (vi) for purposes of the restriction on disclosure, non-public information concerning Collaboration Targets, Compounds and Products (including the identity, structure and/or properties, in each case, specific to the Collaboration Targets, Compounds and Products in the Field, except for the GalXC Platform) and information contained in the Research Plans shall be deemed Confidential Information of both Parties; and (vii) for purposes of the restriction on disclosure, Joint Know-How shall be deemed Confidential Information of both Parties and kept confidential per the terms of Article 11, unless subsequently assigned to the other Party as set forth in Article 10, in which case, such Know-How shall become the Confidential Information of the assignee. For clarity, nothing in the foregoing shall limit Sections 3.1 through 3.3 or the exclusive licenses granted to Novo pursuant to Section 7.1). Product-Specific Know-How shall be used by the Parties only in accordance with the terms of this Agreement.

1.20 "**Confidentiality Agreement**" has the meaning set forth in Section 19.16.

1.21 "**Continuation Targets**" has the meaning set forth in Section 2.3.4.

1.22 "**Control**" or "**Controlled**" means, with respect to any Know-How, or intellectual property right (including any Patent Right), that a Party owns, or has a license to, such Know-How or intellectual property right, in each case to the extent such Party has the power to grant to the other Party access, a license, or a sublicense (as applicable) to the same on the terms and conditions set forth in this Agreement; provided that, as to Know-How or Patent Rights first licensed or acquired by Dicerna from a Third Party after the Effective Date, such Know-How or Patent Right will be included as "Controlled" by Dicerna only if Novo elects to accept a sublicense or license in accordance with Section 7.8.1. Notwithstanding anything in this Agreement to the contrary, in the event of a Change of Control of a Party, the Party shall be deemed to not Control any intellectual property right that is owned or controlled by the Acquirer or its Affiliates prior to or after the Change of Control, other than Know-How and intellectual property rights Controlled by such Party prior to the Change of Control.

1.23 "**Co-Promotion Agreement**" means a co-promotion agreement for a Co-Development Program for which the Parties have agreed to co-promote according to Sections 2.3.2(c), 2.3.3(b) (in the US for Dicerna's option) or 3.3 and to be negotiated by the Parties based on the co-promotion principles as set forth in Exhibit G.

1.24 "**Cover**", "**Covering**", or "**Covered**" means, with respect to Patent Rights, where the use, Manufacture, sale, offer for sale, import or export of subject matter (including, but not limited to, goods and services such as Products), absent ownership or a license, would infringe at least one issued and unexpired claim (or a pending claim, if such pending claim were to issue without modification from a claim in the application as filed) of such Patent Rights which has not been declared invalid or unenforceable by a patent office or a court of competent jurisdiction in a decision that is unappealable or unappealed.

1.25 "**CRO**" has the meaning set forth in Section 4.4.2.

1.26 "**Data Package**" means, with respect to a given Collaboration Target, a data package that includes each of the following: (a) relevant data related to such Collaboration Target, including design and synthesis of the Compound(s) Directed To the Collaboration Target, and any *in vitro* and *in vivo* validation and other related research and preclinical data and information relating to such Compound(s) and Collaboration Target; (b) a reasonably detailed analysis of the data related to such Collaboration Target; and (c) such other information regarding such Collaboration Target as Novo may otherwise reasonably request that is in Dicerna's possession and control.

1.27 "**DCR-HBVS**" means the GalXC Molecule known as DCR-S219 that is identified in clinicaltrials.gov with the clinical trial identifier NCT03772249.

1.28 "**Default Countries**" means, with respect to Program Inventions and/or Product-Specific Patents Covering Compounds and Products advanced to at least a Phase 1 Clinical Trial, each patent application shall at least be filed in the countries identified in Exhibit J.

1.29 "**Development**" or "**Develop**" means, with respect to a Compound or Product, any activities after nomination as a Development Candidate for such Compound or Product, including research, preclinical and other non-clinical testing, test method development and stability testing, toxicology, formulation, Manufacture, process development, clinical studies (including manufacturing in support thereof, but excluding any commercial manufacturing), statistical analysis and report writing, the preparation and filing of regulatory filings and all regulatory affairs related to the foregoing. When used as a verb, **"Developing"** means to engage in Development and **"Developed"** has a corresponding meaning. For clarity, "**Development**" shall not include any Research or Commercialization activities.

1.30 "**Development and Regulatory Milestone Event**" has the meaning set forth in Section 8.4.

1.31 "**Development and Regulatory Milestone Payment**" has the meaning set forth in Section 8.4.

1.32 "**Development Budget**" means, with respect to a Compound, projection of expected total Development Expenses through Marketing Authorization from nomination as a Development Candidate.

1.33 "**Development Candidate**" or "**DC**" has the meaning set forth in Section 2.2.

1.34 "**Development Expenses**" means all expenses incurred in accordance with the Accounting Standards, directly or indirectly, in connection with the Development activities hereunder, including without limitation expenses incurred in connection with: (i) obtaining, maintaining and/or expanding Regulatory Approval and/or the ability to Manufacture, formulate, use, fill, ship and/or sell a Product; (ii) data management, statistical designs and studies, document preparation, and other expenses associated with clinical testing programs; (iii) costs of process development or improvement, Manufacturing Expenses (including Manufacturing activities occurring prior to nomination of a Development Candidate approved by Novo for use in future Development activities and Manufacturing Expenses incurred in Manufacturing Product inventory in preparation for commercial sales), scale-up, validation and recovery (including plant costs), in each case including all FTE Expenses for FTEs who perform activities in furtherance of the foregoing.

1.35 "**Development Plan**" means, with respect to a Development Candidate, an outline of Development activities to be conducted and corresponding objectives to be achieved up until Commercialization.

1.36 "**Dicerna Background IP**" has the meaning set forth in Section 10.4.

1.37 "**Dicerna Excluded Programs**" means the research and development of compounds or products by Dicerna and its Affiliates Directed To the Targets identified in subsection (i) of the definition of "Blocked Targets" in Section 1.18 above.

1.38 "**Dicerna Indemnified Party**" has the meaning set forth in Section 17.2.

1.39 "**Dicerna Orphan Product**" has the meaning set forth in Section 3.3.

1.40 "**Dicerna Reserved Orphan Liver Target**" has the meaning set forth in Section 2.3.2.

1.1 "**Direct Manufacturing Costs**" means all direct manufacturing costs and charges for a given Compound or Product, including: (a) direct manufacturing charges reasonably allocable to Compounds or Products, such as purchase of materials, (b) storage and insurance, packaging and shipment thereof, and (c) FTE Expenses (e.g., quality, manufacturing, and chemistry) used therefor and equipment purchased for Compounds or Products and excluding: (y) amortization of property or equipment not specifically related to manufacturing of Products and (z) allocation of general corporate overhead.

1.2 "**Directed To**" means, with regard to an RNAi product or oligonucleotide product and Target, [* * *]. For clarity, if the defined term "Directed To" is separated, such as when required grammatically (*e.g.*, when discussing Targets "To which a product is Directed"), such separated term shall maintain the same meaning set forth in the previous sentence.

1.3 "**Discontinued Target**" means a Target with [* * *] pursuant to Section 2.3.5 or as to which Novo has exercised a right of termination under Section 14.2. In case of termination of this Agreement in its entirety under Section 14.2 or under Section 14.3 then all Collaboration Targets shall be Discontinued Targets.

1.4 "**Discovery Period**" has the meaning set forth in Section 2.1.1.

1.5 "**Dispute**" has the meaning set forth in Section 19.6.1.

1.6 "**Distribution Expenses**" means all expenses incurred in accordance with the Accounting Standards, directly or indirectly, in connection with the distribution of Products, including, without limitation, expenses for customer services, order entry, billing, shipping, insurance, tariffs, customs, duties and similar taxes, credit and collection and other such activities, in each case: (i) except to the extent deducted in the calculation of Net Sales and (ii) including all FTE Expenses for FTEs who perform activities in furtherance of the foregoing.

1.7 "**DOJ**" has the meaning set forth in Section 13.1.

1.8 "**Dollar**" means the United States of America dollar, and "$" and "USD" will be interpreted accordingly.

1.9 "**Effective Date**" means the HSR Clearance Date.

1.10 "**Effective Patent Claim**" means any Valid Claim of: (a) a patent; or (b) a pending patent application; in each case claiming a method of use of a Compound or Product for an approved use of a Product or the composition of matter (including formulations) of a Compound or Product and included within the Licensed Patent Rights (including Product-Specific Patents).

1.11 "**EMA**" means the European Medicines Agency and any successor thereto.

1.12 "**Escrow Agent**" means Silicon Valley Bank or such other bank or other entity selected by the Parties as the escrow agent under the Escrow Agreement.

1.13 "**Escrow Agreement**" means the Escrow Agreement entered into as of the Signing Date by and among the Escrow Agent, Novo and Dicerna to effectuate the intent and purposes of Section 8.1.

1.14 "**Excluded Claim**" has the meaning set forth in Section 19.6.5.

1.15 "**Excluded Field**" means any and all uses of the GalXC Platform, including any and all use of the GalXC Molecules generated by the GalXC Platform, for diagnostic, therapeutic, or prophylactic uses in humans, in an indication whose [* * *].

1.16 "**Existing Patents**" has the meaning set forth in Section 16.2.3(a).

1.17 "**Expenses and Payments**" has the meaning set forth in Section 9.5.1.

1.18 "**FDA**" means the United States Food and Drug Administration and any successor thereto.

1.19 "**FFDCA**" has the meaning set forth in Section 16.1.5.

1.20 "**Field**" means any and all diagnostic, therapeutic or prophylactic uses in humans for indications which achieve their beneficial effect using a [* * *] except [* * *].

1.21 "**First Commercial Sale**" means, in a country, the first sale of a Product by Novo or Dicerna or their respective Affiliates or their sublicensees, to an unaffiliated Third Party in that country after receipt of all Marketing Authorizations required to market and sell the Product have been obtained in the country in which such Product is sold. Sales for purposes of testing the Product and sample purposes shall not be deemed a First Commercial Sale. Furthermore, for purposes of clarity, the term "First Commercial Sale" as used in this Agreement shall not include: (i) any distribution or other sale solely for so-called treatment investigational new drug sales, named patient sales, compassionate or emergency use sales or pre-license sales, in each case provided that such Product is distributed without charge or sold at or below cost; (ii) intercompany transfers to Affiliates of a Party or between such entities and a sublicensee of a Party or an Affiliate, provided a subsequent sale to an unaffiliated Third Party by such Affiliate of a Party or sublicensee is not considered an intercompany transfer; nor (iii) other similar non-commercial sales.

1.22 "**FTC**" has the meaning set forth in Section 13.1.

1.23 "**FTE**" means, with respect to a person, the equivalent of the work of one (1) employee full time for [* * *] (consisting of at least [* * *] per year (with no further reductions for vacations and holidays)). Overtime, and work on weekends, holidays and the like will not be counted with any multiplier (*e.g.*, time-and-a-half or double time) toward the number of hours that are used to calculate the FTE contribution. The portion or multiple of an FTE billable by the applicable Party for one (1) individual during a given accounting period shall be determined by dividing the number of hours worked by said individual on the work to be conducted under the Agreement during

such accounting period and the number of FTE hours applicable for such accounting period based on [* * *] per Calendar Year, applied consistently throughout the Calendar Year. For clarity, no individual person can ever constitute more than a single FTE.

1.24 "**FTE Expenses**" means the FTE Rate multiplied by the applicable number of FTEs.

1.25 "**FTE Rate**" means, for the period commencing on the Effective Date until such time as the Parties agree otherwise, [* * *] per year, subject to annual increases or decreases beginning on January 1, 2021 to reflect the percentage increase or decrease in the Consumer Price Index – All Urban Consumers, US City Average, All Items (as quoted by the U.S. Department of Labor, Bureau of Labor Statistics), and similarly calculated year to year increases each subsequent Calendar Year. The FTE Rate shall be deemed to encompass compensation for expenses of salaries, benefits, supplies, other employee expenses, and supporting overhead and general and administration allocations.

1.26 "**GalXC Molecule**" means an RNAi molecule conjugated to one or more N-acetylgalactosamine (GalNAc) ligands and designed to be Directed To a Target.

1.27 "**GalXC Patents**" has the meaning set forth in Section 10.7.1.

1.28 "**GalXC Platform**" means the RNAi technology platform Controlled by Dicerna, generating and using GalXC Molecules to silence one or more mRNA molecules.

1.29 "**GalXC Platform IP**" means [* * *].

1.30 "**Gatekeeper**" has the meaning set forth in Section 2.4.1.

1.31 "**Generic Product**" means, as to a given Product, a product whose sale is not authorized by Novo or its Affiliates or sublicensees that is (a) approved by a Regulatory Authority as therapeutically equivalent to such Product in a country for at least one approved indication of the Product in such country, or (b) is approved by a Regulatory Authority by making cross-reference to and relying on the safety and effectiveness data provided to such Regulatory Authority for the Product on the basis that it demonstrates bioequivalence or biosimilarity or interchangeability to such Product.

1.32 "**Global Profits**" means, as to a given Product, Net Sales less the following items: Manufacturing Expenses, Marketing Expenses, Sales Expenses, Patent Expenses, Distribution Expenses, and Development Expenses, for a given period. For the avoidance of doubt, Co-Development Pre-Option Expenses will not be used to calculate Global Profits.

1.33 "**Good Clinical Practices**" or "**GCP**" means all applicable current Good Clinical Practice standards for the design, conduct, performance, monitoring, auditing, recording, analyses and reporting of Clinical Trials, including, as applicable, (a) as set forth in the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use ("ICH") Harmonized Tripartite Guideline for Good Clinical Practice (CPMP/ICH/135/95) and any other guidelines for good clinical practice for trials on medicinal products in the

Territory, (b) the Declaration of Helsinki (2004) as last amended at the 52nd World Medical Association in October 2000 and any further amendments or clarifications thereto, (c) US Code of Federal Regulations Title 21, Parts 50 (Protection of Human Subjects), 56 (Institutional Review Boards) and 312 (Investigational New Drug Application), as may be amended from time to time, and (d) the equivalent Applicable Laws in any relevant country, each as may be amended and applicable from time to time.

1.34 "**Good Laboratory Practices**" or "**GLPs**" means all applicable Good Laboratory Practice standards, including, as applicable: (a) as set forth in the then-current good laboratory practice standards promulgated or endorsed by the FDA as defined in 44 C.F.R. Part 58; and (b) the equivalent Applicable Laws in any relevant country, each as may be amended and applicable from time to time.

1.35 "**Good Manufacturing Practices**" or "**GMPs**" means all applicable Good Manufacturing Practices including, as applicable: (a) the principles detailed in the US Current Good Manufacturing Practices, 21 C.F.R. Parts 4, 210, 211, 601, 610 and 820; (b) European Directive 2003/94/EC and Eudralex 4; (c) the principles detailed in the WHO TRS 986 Annex 2, TRS 961 Annex 6 and TRS 957 Annex 2; (d) ICH Q7 guidelines and (e) the equivalent Applicable Laws in any relevant country, each as may be amended and applicable from time to time.

1.36 "**Good Research Practices**" or "**GRP**" means research practices consistent with the Research Quality Association (RQA), 2014 Quality in Research Guidelines for Working in Non-Regulated Research.

1.37 "**Governmental Authority**" means any court, commission, authority, department, ministry, official or other instrumentality of, or being vested with public authority under any law of, any country, state or local authority or any political subdivision thereof, or any association of countries.

1.38 "**Hepatocyte Target**" means any Target [* * *].

1.39 "**HSR Act**" has the meaning set forth in Section 13.1.

1.40 "**HSR Clearance Date**" has the meaning set forth in Section 13.1.

1.41 "**Improvement**" means any (a) modification, enhancement or change to the Patent Rights or Know-How Controlled by a Party and its Affiliates and existing as of or after the Signing Date and (b) Patent Rights claiming priority to the Patent Rights included in Dicerna's Background IP, with respect to Dicerna, or Novo's Background IP, with respect to Novo.

1.42 "**IND**" means an investigational new drug application filed with the FDA with respect to a Compound or a Product, or an equivalent application filed with a Regulatory Authority in a country other than the United States required to commence clinical trials of a pharmaceutical product.

1.43 "**IND Approval**" of a Product means that an IND for such Product has been submitted to the FDA or equivalent Regulatory Authority and not rejected (including placed on clinical hold) by the FDA or equivalent Regulatory Authority within [* * *] after such submission.

1.44 "**Indemnified Party**" has the meaning set forth in Section 17.3.1.

1.45 "**Indemnifying Party**" has the meaning set forth in Section 17.3.1.

1.1 "**Initial Discovery Period**" has the meaning set forth in Section 2.1.1.

1.2 "**Initial Party**" has the meaning set forth in Section 10.7.6.

1.3 "**Initial R&D Collaboration Term**" has the meaning set forth in Section 4.1.2.

1.4 "**Initial Targets**" has the meaning set forth in Section 8.1.2.

1.5 "**Initiation of GLP Tox Studies**" means the first toxicology testing of a Compound under GLP conditions.

1.6 **"Internal Compliance Codes"** means a Party's internal policies and procedures intended to ensure that a Party complies with Applicable Laws, Party Specific Regulations, and such Party's internal ethical, medical and similar standards.

1.7 "**Internal Revenue Code**" has the meaning set forth in Section 9.4.2.

1.8 "**Invention**" means any invention, composition of matter, formulation, article of manufacture, method of manufacture, method of use or other subject matter, whether patentable or not.

1.9 "**Joint Intellectual Property**" means Joint Patent Rights and Joint Know-How.

1.10 "**Joint Inventions**" has the meaning set forth in Section 10.5.1.

1.11 "**Joint Know-How**" has the meaning set forth in Section 10.5.1.

1.12 "**Joint Patent Right**" has the meaning set forth in Section 10.5.1.

1.13 "**JSC**" has the meaning set forth in Section 6.5.1.

1.14 "**JSC Chair**" has the meaning set forth in Section 6.5.1.

1.15 "**Know-How**" means all technical, scientific, and other information, know-how, data, Inventions, discoveries, trade secrets, specifications, instructions, techniques, processes, designs, drawings, formulae, methods, practices, protocols, expertise and other information and technology applicable to formulations, compositions or products or to their Manufacture, development, registration, use, marketing or sale or to methods of assaying or testing them, and all biological, chemical, pharmacological, biochemical, toxicological, pharmaceutical, physical and analytical, safety, quality control, manufacturing, preclinical and clinical data relevant to any of the

foregoing. For clarity, Know-How includes any such information comprised or embodied in any applicable physical materials, and excludes Patent Rights.

1.1 "**Licensed Know-How**" means all Know-How, including Know-How within the GalXC Platform IP, that is Controlled by Dicerna (or one of its Affiliates) and that is: (a), necessary or reasonably useful for the Research, Development, registration, Manufacture (including formulation), use or Commercialization of a Compound or Product in the Field (which would include all Know-How relating to targeting of Hepatocyte Targets using the GalXC Platform, excluding Know-How exclusively relating to Dicerna Reserved Orphan Liver Targets that are not designated by Novo as Collaboration Targets under Section 2.3.2 or exclusively relating to Discontinued Targets); or (b) acquired (subject to Section 7.8.1), licensed (subject to Section 7.8.1), conceived, developed, created, made or reduced to practice, whether in the course of performing the R&D Program during the Term or otherwise, including Dicerna's rights in any Joint Know-How and any Improvements to the foregoing Know-How described in subclause (a).

1.2 "**Licensed Patent Rights**" means any and all Patent Rights, including Patent Rights within the GalXC Platform IP, that are Controlled by Dicerna (or one of its Affiliates) and that are: (a) listed in Exhibit E, (b) necessary or reasonably useful for the Research, Development, registration, Manufacture (including formulation), use or Commercialization of a Compound or Product in the Field (which would include all Patent Rights directed to Targets using the GalXC Platform excluding Patent Rights directed exclusively to Dicerna Reserved Orphan Liver Targets that are not designated by Novo as Collaboration Targets under Section 2.3.2 or exclusively relating to Discontinued Targets), (c) acquired (subject to Section 7.8.1), licensed (subject to Section 7.8.1), conceived, developed, created, made or reduced to practice, whether in the course of performing the R&D Program during the Term or otherwise, including Dicerna's rights in any Joint Patent Rights, or (d) directed to Know-How described in subclause (b) of the definition of "Licensed Know-How," including Dicerna's rights in any Joint Patent Rights.

1.3 "**Licensed Technology**" means, individually or collectively, the Licensed Patent Rights and the Licensed Know-How.

1.4 "**Lilly**" has the meaning set forth in Section 1.133.

1.5 "**Lilly Agreement**" means that certain Collaboration and License Agreement between Eli Lilly and Company or its permitted successors and assigns ("**Lilly**") and Dicerna Pharmaceuticals, Inc. together with Dicerna Cayman dated October 25, 2018, as (subject to Section 2.5) amended and in effect from time to time.

1.6 "**Losses**" has the meaning set forth in Section 17.1.

1.7 "**Major European Market**" means any of [* * *].

1.8 "**Major Territory**" means: [* * *].

1.9 "**Manufacturing**" or "**Manufacture**" means any and all activities directed to manufacturing, processing, packaging, labeling, filing, finishing, assembly, shipping, storage, or

freight of any pharmaceutical product (or any components or process steps involving any product or any companion diagnostic), placebo, or comparator agent, as the case may be, including quality assurance and stability testing, characterization testing, quality control release testing of drug substance and drug product, quality assurance batch record review and release of product, process development, qualification, and validation, scale-up, pre-clinical, clinical, and commercial manufacture and analytic development, and product characterization.

1.10 "**Manufacturing Expenses**" means all expenses incurred in accordance with the Accounting Standards, directly or indirectly, in connection with Manufacturing a pharmaceutical product, including without limitation the costs incurred for all materials (including devices sold as part of a Product for a single sales price, or included as part of a Product under Development), labor, access and use of a portion of a Manufacturing facility, reasonably allocable Manufacturing overhead and out-of-pocket costs paid to Third Parties, in each case including all FTE Expenses for FTEs who perform activities in furtherance of the foregoing, but in any event excluding any unreserved, allocated idle capacity costs and charges that exceed in the aggregate [* * *] of a manufacturing facility relating to or occasioned by unused manufacturing capacity not otherwise committed to Products.

1.11 "**Mapped Target**" means a Collaboration Target for which design and generation of [* * *] or more distinct Compounds Directed To such Target has occurred and that such Compounds Directed To such Target induce an inhibition, disruption or modulation of Target-derived mRNA resulting in reduced expression of the Target-derived mRNA.

1.12 "**Marketing Authorization**" means, collectively, all Regulatory Approvals (including any applicable pricing, reimbursement or access approvals) from the relevant Regulatory Authority (including FDA and EMA) necessary to initiate marketing and selling a Product in such country or jurisdiction.

1.13 "**Marketing Expenses**" means all expenses incurred in accordance with the Accounting Standards, directly or indirectly, in connection with the marketing, promotion and advertising of Products, including, without limitation, expenses for preparing and reproducing detailing aids, promotional materials, expenses of professional education, product related public relations, relationships with opinion leaders and professional societies, market research and market studies (before and after Regulatory Approval), healthcare economics studies, promotional events, attendance of professional conferences and trade shows, and other similar activities directly related to the Products, in each case including all FTE Expenses for FTEs who perform activities in furtherance of the foregoing.

1.14 "Net Sales" [* * *]:

1.15 "**New Chemical Entity Regulatory Exclusivity**" means the exclusivity granted to a drug that contains no active moiety that has been previously approved by FDA under Section 505(b) of the FFDCA (or any successor statutory provision or treaty that provides for an extension of such exclusivity) or equivalent exclusivity in countries outside the United States, which exclusivity shall be deemed, for purposes of Section 8.6.2(b), not to extend beyond [* * *] following the grant of such exclusivity for the applicable Product in the applicable country.

1.16 "**Notice of Dispute**" has the meaning set forth in Section 19.6.1.

1.17 "**Novo Background IP**" has the meaning set forth in Section 10.3.

1.18 "**Novo Competitor**" means [* * *].

1.19 "**Novo Indemnified Party**" has the meaning set forth in Section 17.1.

1.20 "**Novo Intellectual Property**" means, individually or collectively, Novo Background IP, Novo Product Inventions, Novo Patents and Novo Know-How.

1.21 "**Novo Know-How**" means any and all Know-How Controlled by Novo (or one of its Affiliates) that is: (a) existing as of the Signing Date or generated or acquired outside the scope of the R&D Program and this Agreement, including any Improvements to any of the foregoing that is necessary or reasonably useful for the Research, Development, registration, Manufacture (including formulation), use or Commercialization of a Product in the Field; or (b) conceived, Developed, created, made or reduced to practice in the course of performing the R&D Program during the Term, subject to Section 10.4, but including Novo's rights in any Joint Know-How.

1.22 "**Novo's Own Target**" means any Collaboration Target which Novo has identified, and for which it has generated Confidential Information or has independently conducted research or development, prior to the Signing Date or during the R&D Collaboration Term and prior to its designation as a Collaboration Target.

1.23 "**Novo Patents**" means any and all Patent Rights Controlled by Novo and its Affiliates that are: (a) existing as of the Signing Date or generated or acquired outside the scope of the R&D Program and this Agreement, including any improvements to any of the foregoing that is necessary or reasonably useful for the Research, Development, registration, Manufacture (including formulation), use or Commercialization of a Product in the Field; or (b) directed to Know-How described in subclause (b) of the definition of "Novo Know-How," subject to Section 10.4, but including Novo's rights in any Joint Patent Rights. Novo Patents shall be disclosed in writing, which disclosures shall be updated from time to time, in accordance with Section 10.1.

1.24 "**Novo Product Inventions**" means any Invention discovered or conceived during the Term solely by or on behalf of Novo or Affiliates of Novo (and not by Dicerna, its Affiliates or sublicensees) arising in connection with the Research Plan, Development Plan or any other activities in connection with the R&D Program or this Agreement, that is Directed To a Compound, Product, or Collaboration Target(s). For the avoidance of doubt, Novo Product Inventions do not include any Dicerna Background IP (including GalXC Platform IP), any Product-Specific Patents owned solely or jointly by Dicerna or any and Product-Specific Know-How owned solely or jointly by Dicerna.

1.25 "**Novo Product Patent**" means any Patent Right Covering a Novo Product Invention.

1.26 "**Novo Review Period**" has the meaning set forth in Section 2.1.4.

1.27 "**Orphan Liver Indication**" means an indication for use of a drug to treat a rare disease or condition of the liver where the number of people affected by the disease or condition is less than 200,000 persons or where the indication for use otherwise meets the criteria for orphan drug designation under section 526(a) of the FFDCA and 21 C.F.R. 316.21.

1.28 "**Party Specific Regulations"** means all judgments, decrees, orders or similar decisions issued by any Governmental Authority specific to a Party, and all consent decrees, corporate integrity agreements, or other agreements or undertakings of any kind by a Party with any Governmental Authority, in each case as the same may be in effect from time to time and applicable to a Party's activities contemplated by this Agreement.

1.29 "**Patent Expenses**" means any expenses incurred by either Party in connection with the drafting, filing, prosecution, maintenance, enforcement or defense of Patent Rights under Article 10.

1.30 "**Patent Rights**" means the rights and interests in and to issued patents and pending patent applications (which, for purposes of this Agreement, include certificates of invention, applications for certificates of invention and priority rights) in any country or region where filed, including all provisional applications, substitutions, continuations, supplementary protection certificates, continuations-in-part, continued prosecution applications including requests for continued examination, divisional applications and renewals, and all letters patent or certificates of invention granted thereon, and all reissues, reexaminations, extensions (including pediatric exclusivity patent extensions), term restorations, renewals, substitutions, confirmations, registrations, revalidations, revisions and additions of or to any of the foregoing, and all foreign counterparts of any of the foregoing.

1.31 "**Patent Working Group**" has the meaning set forth in Section 6.4.

1.32 "**Payee**" has the meaning set forth in Section 9.4.1.

1.33 "**Payor**" has the meaning set forth in Section 9.4.1.

1.34 "**Permitted Subcontractors**" has the meaning set forth in Section 4.8.

1.35 "**Person**" means any individual, corporation, partnership, association, joint-stock company, trust, unincorporated organization or government or political subdivision thereof.

1.36 "**Phase 1 Clinical Trial**" means a clinical trial of a Product generally consistent with 21 C.F.R. §312.21(a) or equivalent trial outside of the United States, or a phase 1/2 clinical trial where a subsequent Phase 2 Clinical Trial will be required.

1.37 "**Phase 2 Clinical Trial**" means a clinical trial of a Product generally consistent with 21 C.F.R. §312.21(b) or equivalent trial outside of the United States.

1.38 "**Phase 3 Clinical Trial**" means a clinical trial of a Product generally consistent with 21 C.F.R. §312.21(c) or equivalent trial outside of the United States.

1.39 "**Pivotal Study**" means a human clinical trial that demonstrates the statistical efficacy and safety of a Product and that is the final stage of clinical testing prior to and in support of the filing of an NDA or MAA for a Marketing Authorization, whether constituting a Phase 2 Clinical Trial or Phase 3 Clinical Trial in the United States or a similar trial in other jurisdictions.

1.40 "**PMDA**" means the Japanese Pharmaceutical and Medical Device Association and any successor thereto.

1.41 "**Pre-Clinical Milestone Event**" has the meaning set forth in Section 8.3.1.

1.42 "**Pre-Clinical Milestone Payment**" has the meaning set forth in Section 8.3.1.

1.43 "**Pre-Reserved Targets**" means the up to [* * *] Targets that have been or may be pre-cleared by the Gatekeeper prior to the Effective Date and, following such clearance, will be reserved for designation by Novo or the JSC as Collaboration Targets hereunder following the Effective Date.

1.44 "**Product**" means any Compound formulated for use in the Field.

1.45 "**Product-Specific Know-How**" means Know-How directed to a Compound, Product, or Collaboration Target(s) but not directed to the GalXC Platform.

1.46 "**Product-Specific Patents**" has the meaning set forth in Section 10.7.2.

1.47 "**Program Inventions**" has the meaning set forth in Section 10.5.1.

1.48 "**Program Leader**" has the meaning set forth in Section 6.2.

1.49 "**Project Leader**" has the meaning set forth in Section 6.1.

1.50 "**Proof of Concept Study**" means [* * *].

1.51 "**Proof of Principle**" means [* * *].

1.52 "**R&D Collaboration Term**" has the meaning set forth in Section 4.1.2.

1.53 "**R&D Program**" has the meaning set forth in Section 4.1.1.

1.54 "**Records**" has the meaning set forth in Section 4.6.1.

1.55 "**Regulatory Approval**" means, collectively, any and all approvals (including supplements, amendments, pre- and post-approvals, pricing and reimbursement approvals), licenses, registrations or authorizations (including marketing and labeling authorizations) of any Regulatory Authority that are necessary for the Research, Development, registration, Manufacture (including formulation), distribution, importation, exportation, use, and Commercialization of a pharmaceutical product (including a Compound or Product) in a given jurisdiction.

1.56 "**Regulatory Authority**" means the FDA or any counterpart of the FDA outside the United States, or other Governmental Authority with authority over the Research, Development, registration, Manufacture (including formulation), and Commercialization of a pharmaceutical product (including a Compound or Product), which may include the authority to grant the required reimbursement and pricing approvals for such sale.

1.57 "**Regulatory Documentation**" has the meaning set forth in Section 16.1.6.

1.58 "**Research**" means all activities related to the research, identification, generation, formatting, screening, testing (including *in silico*, *in vitro*, *ex vivo* human validation systems and animal models, but not in human subjects), stability testing, toxicology and formulation of Collaboration Targets or Compounds up until nomination as a Development Candidate. When used as a verb, "**to Research**" and "**Researching**" means to engage or engaging in Research.

1.59 "**Research Plan**" has the meaning set forth in Section 4.1.4.

1.60 "**Returned Compounds and Products**" has the meaning set forth in Section 15.2.1.

1.61 "**RNAi**" means a double-stranded RNA molecule that silences or inhibits the expression of a Target.

1.62 "**Roche**" has the meaning set forth in Section 1.18.

1.63 "**Roche Agreement**" has the meaning set forth in Section 1.18.

1.64 "**Royalty**" has the meaning set forth in Section 8.6.1.

1.65 "**Royalty Term**" has the meaning set forth in Section 8.6.2.

1.66 "**Sales Expenses**" means all expenses incurred in accordance with the Accounting Standards, directly or indirectly, in connection with the sales of Products, including pre-launch expenses, to all markets in the Territory including the managed care market, including without limitation sales operations, account managers, district managers, regional managers, fleet, travel and entertainment, supervision, training, sales meetings, and other sales expenses, in each case including all FTE Expenses for FTEs who perform activities in furtherance of the foregoing. For the avoidance of doubt, Sales Expenses will include the start-up expenses associated with a Party's sales force, including recruiting, relocation and other similar expenses.

1.67 "**Senior Representative**" means, with respect to a Party, an executive officer of such Party having greater seniority than such Party's JSC representatives, which executive officer such Party designates for the escalation of a disagreement within the JSC.

1.68 "**Target**" means: [* * *].

1.69 "**Taxes**" has the meaning set forth in Section 9.4.

1.70 "**Term**" has the meaning set forth in Section 14.1.

1.71 "**Territory**" means all of the countries and territories in the world.

1.72 "**Third Party**" means any Person other than Novo or Dicerna or an Affiliate of Novo or Dicerna.

1.73 "**United States**" or "**U.S.**" means the United States of America and its territories and possessions.

1.74 "**Upfront Payment**" has the meaning set forth in Section 8.1.1.

1.75 "**Valid Claim**" means (a) a claim of an issued and unexpired patent that has not been (i) held permanently revoked, unenforceable, unpatentable or invalid by a decision of a court or governmental body of competent jurisdiction, unappealable or unappealed within the time allowed for appeal, (ii) disclaimed or rendered unenforceable through disclaimer or otherwise, or (iii) abandoned, or (b) a pending claim of a pending patent application, which claim does not remain pending later than the [* * *] anniversary of the First Commercial Sale of the relevant Product, and has not been abandoned or finally rejected without the possibility of appeal or refiling or without such appeal having been taken or refiling having been made within the applicable time periods.

1.76 "**Validated Target**" has the meaning forth in Section 2.1.3.

1.77 "**Validated Target Criteria**" means [* * *].

1.78 "**VAT**" has the meaning set forth in Section 9.4.4.

1.79 "**Working Group**" has the meaning set forth in Section 6.4.

1.80 "**Work Flow Plan**" has the meaning set forth in Section 2.1.3.

2. TARGET SELECTION AND VALIDATION

2.1 Target Selection, Validation, and Development Candidates.

2.1.1 Collaboration Targets. For the initial [* * *] period of the R&D Collaboration Term ("**Initial Discovery Period**"), the Parties will engage in a collaborative effort to identify approximately thirty (30) or more Hepatocyte Targets which are confirmed available through the Gatekeeper process described in Section 2.4 in the Field that the Parties wish to further Research and Develop, pursuant to the R&D Program (such Targets individually and collectively referred to as "**Collaboration Targets**"), provided that such time period will be extended for up to [* * *] additional [* * *] terms if Dicerna is materially delayed with respect to generating at least [* * *] (or, if fewer, such number of Collaboration Targets designated by the Parties) Mapped Targets per [* * *] period over the course of the Initial Discovery Period or if the Parties agree in writing that additional time is needed to identify Collaboration Targets and Mapped Targets (the Initial Discovery Period plus any such extensions, the "**Discovery Period**"). For clarity, if Dicerna generates more than the minimum number of Mapped Targets in any such [* * *] period, such excess shall count toward the minimum for the subsequent [* * *] period(s). Any Hepatocyte Target to be

included as a Collaboration Target will be subject to confirmation of its availability to Novo through the Gatekeeper process described in Section 2.4. Notwithstanding anything else in this Agreement, the Parties agree that on a Collaboration Target-by-Collaboration Target basis, Dicerna's Research obligations end on achievement of the Proof of Principle for a Compound Directed To such Collaboration Target.

2.1.1 Mapped Targets. During the Discovery Period, on a per [* * *] basis, Dicerna will deliver Mapped Targets for [* * *] or more Collaboration Targets selected by Novo or the JSC to be Mapped Targets. For the avoidance of doubt, once a Collaboration Target becomes a Mapped Target, it is still considered to be a Collaboration Target.

2.1.2 Validated Targets and Proof of Principle. During the R&D Collaboration Period, Dicerna will use Commercially Reasonable Efforts to perform Research of Compounds and Novo will use Commercially Reasonable Efforts to conduct the Research activities it has agreed to undertake, both as set forth in Exhibit A (as may be amended by the JSC from time to time, the "**Work Flow Plan**") and the applicable Research Plans, with the objective for the JSC to nominate at least [* * *] "**Validated Targets**" achieving the applicable Validated Target Criteria, provided that Novo shall have the right to designate any Collaboration Target as a Validated Target at any time in its discretion, whether or not such Collaboration Target has achieved the applicable Validated Target Criteria. For the avoidance of doubt, the reference to [* * *] Validated Targets is not intended in any way to limit or guarantee the total number of Collaboration Targets which may be designated as Validated Targets. Dicerna shall, as determined by the JSC, engage in further evaluation and testing of Collaboration Targets, Validated Targets and Compounds, including, but not limited to, evaluation and testing of *in vivo* efficacy, and evaluation and testing of preclinical pharmacology of Compounds, in order to achieve Proof of Principle for at least [* * *] Compounds to the extent feasible. For the avoidance of doubt, even when a Collaboration Target is nominated as a Validated Target or a Compound Directed To a Collaboration Target has achieved Proof of Principle, it is still considered a Collaboration Target. For clarity, Research results are inherently uncertain and the Parties acknowledge that there is no assurance such results can be achieved.

2.1.1 Data Packages and Access to Tissue Samples. From time to time at the reasonable request of Novo, and in any case promptly upon the end of the R&D Collaboration Term, Dicerna shall promptly provide to Novo an accurate and reasonably detailed copy of the Data Packages for each Collaboration Target, which Data Packages may be used by Novo for purposes of determining whether to designate a Collaboration Target as a Validated Target and/ or having achieved Proof of Principle. Following Dicerna's provision of each Data Package for each Collaboration Target at the end of the R&D Collaboration Term: (i) Novo shall review such Data Package, and Novo shall notify Dicerna, no later than [* * *] after receiving such Data Package, of any reasonable requests for additional information and records for the applicable Collaboration Target that is within Dicerna's possession and control, and Dicerna shall respond to such requests within [* * *] thereof; and (ii) Novo shall have at least [* * *] following the receipt of such Data Package or additional information and records to decide whether to designate the applicable Collaboration Target as a Validated Target and/ or having achieved Proof of Principle, provided that such [* * *] time period shall be extended by the number of Calendar Days equal to the number of Calendar Days after such [* * *] period during which Dicerna failed to provide such reasonably

requested additional information, if any (each such time period following receipt of a Data Package at the end of the R&D Collaboration Term, a "**Novo Review Period**"). Further, as agreed in the applicable Research Plan, Dicerna shall, in the conduct of pharmacology studies during the R&D Collaboration Term and as reasonably requested by Novo, provide to Novo at Novo's expense for shipping thereof reasonable samples, such as blood and certain organs (e.g. liver, testes and accessory sex glands) for early safety assessment of the relevant Compounds.

2.2 Development Candidates. During the R&D Collaboration Term, the JSC or Novo may nominate one or more Compound(s) Directed To one or more Validated Target(s) (each a "**Development Candidate**" or "**DC**") which have achieved Proof of Principle. If more than [* * *] DCs are nominated, it shall be deemed an increase in the scope of the Agreement and any DCs in excess of [* * *] shall be subject to the additional payment requirements set forth in Section 8.3.2. For the avoidance of doubt, either the JSC or Novo, in its discretion, is free to cause such increase in scope. From time to time at the reasonable request of Novo, and in any case promptly upon the end of the R&D Collaboration Term, Dicerna shall promptly provide to Novo a report including all material data generated by Dicerna regarding Validated Targets and such other information reasonably requested by Novo regarding evaluation and testing of Compounds Directed To one or more Validated Targets. Following Dicerna's provision of such report at the end of the R&D Collaboration Term: (i) Novo shall review such report, and Novo shall notify Dicerna, no later than [* * *] after receiving such report, of any reasonable requests for additional information and records related to Compounds that is within Dicerna's possession or control, and Dicerna shall respond to such requests within [* * *] thereof; and (ii) Novo shall have at least [* * *] following the receipt of such report to decide whether to nominate any Development Candidates, provided that such [* * *] time period shall be extended by the number of Calendar Days equal to the number of [* * *] after such [* * *] period during which Dicerna failed to provide such reasonably requested additional information, if any. Novo shall have final decision on the selection and prioritization for further testing of Development Candidates. The Parties shall collaborate in the conduct of all Research activities to DC nomination as specified in the Research Plans and Work Flow Plan, leveraging the capabilities and expertise of each Party.

2.2.1 IND Activities. For each DC, Novo will lead IND-enabling and clinical development activities to IND filing, except for the first DC, for which Dicerna will lead all activities to IND filing at Novo's expense after achievement of Proof of Principle, provided that the JSC shall establish a Working Group consisting of [* * *] representatives from each Party through which Dicerna will regularly inform Novo regarding the progress of activities prior to IND filing and through which Novo shall be able to provide reasonable feedback and guidance to Dicerna. Dicerna shall reasonably consider and the Parties will mutually implement all such feedback and guidance. During the period when Dicerna is entitled to exercise its co-development options under Section 2.3.3, on a DC-by-DC basis, within [* * *] of the end of each Calendar Year and until expiration of such co-development option, Novo will submit a report to the JSC (and send a copy to Dicerna) for its Development Expenses.

2.2.2 Development Budget and Development Plan. On a DC-by-DC basis, prior to the first dosing of the first patient in the first Clinical Trial, the Parties will also negotiate in good faith (and submit to the JSC) a Development Budget and Development Plan for Development

activities to be performed by Dicerna. If the Parties cannot agree upon a Development Budget or a Development Plan, each Party will submit a separate report to the JSC of a proposed Development Budget or Development Plan for the DC and the JSC will determine a Development Budget or Development Plan. If the JSC is unable to agree on a Development Budget or Development Plan, the Parties shall escalate the issue to Senior Representatives of each Party for resolution. If such Senior Representatives have not succeeded in agreeing upon a Development Budget and Development Plan within [* * *], Novo shall be free to perform or have performed such IND-enabling and clinical development activities without Dicerna's involvement.

2.3 Reserved and Option Targets.

2.3.1 Dicerna Targets. Dicerna represents and warrants that the identity of the Blocked Targets which are the subject of Dicerna Excluded Programs as of the Signing Date are as set forth in the letter dated as of November 14, 2019 from Dicerna to Novo listing the Blocked Targets that are the subject of the Dicerna Excluded Programs.

2.3.2 Dicerna Orphan Liver Target Reservation. At any time during the R&D Collaboration Term, Dicerna shall have the option to designate up to [* * *] Targets that are not designated as Collaboration Targets for worldwide research, development, and commercialization of GalXC Molecules, in each case that is relevant for the treatment of a single Orphan Liver Indication (which can be worldwide) and provided that such Orphan Liver Indication (which can be worldwide) is the sole disease for which Dicerna intends to research, develop and commercialize GalXC Molecules ("**Dicerna Reserved Orphan Liver Target**"). Before Dicerna (by itself or with any Third Party) or its Affiliates, or any Third Party authorized by Dicerna or its Affiliates, initiates research, development or commercialization of a proposed Dicerna Reserved Orphan Liver Target, Dicerna shall notify Novo in writing of its intention to designate a Target as a Dicerna Reserved Orphan Liver Target and of the Orphan Liver Indication for the proposed Dicerna Reserved Orphan Liver Target and provide Novo sufficient documentation for Novo to assess whether such Orphan Liver Indication is validly proposed as an Orphan Liver Indication for which the proposed Dicerna Reserved Orphan Liver Target could be relevant.

(a) After such notification and provision of documentation, Novo shall have [* * *] to notify Dicerna that it either (i) challenges the status of such proposed Dicerna Reserved Orphan Liver Target as one for which there is an Orphan Liver Indication for which Dicerna intends to research, develop and commercialize GalXC Molecules, or (ii) designates the proposed Dicerna Reserved Orphan Liver Target as a Collaboration Target.

(b) If Novo does not provide any such notice: (i) the proposed Target shall become a Dicerna Reserved Orphan Liver Target which Dicerna can Develop and Commercialize for the Orphan Liver Indication; (ii) subject to Section 3.3, the Dicerna Reserved Orphan Liver Target shall be reserved exclusively to Dicerna worldwide and will be promptly reported to the Gatekeeper pursuant to Section 2.4; and (iii) Dicerna shall have the sole and final decision at its sole expense, subject to Novo's subsequent option set forth in Section 3.3, as to the selection and

prioritization of Research activities for each GalXC Molecule Directed To a Dicerna Reserved Orphan Liver Target.

(c) If Novo designates the proposed Dicerna Reserved Orphan Liver Target as a Collaboration Target as contemplated in Section 2.3.2(a)(ii) above, the proposed Dicerna Reserved Orphan Liver Target will become a Collaboration Target and automatically be eligible for designation by Dicerna as a Co-Development Target for co-promotion for the same percentage of details as its designated Co-Development Percentage, subject to Dicerna's written notification to Novo specifying a Co-Development Percentage in accordance with Section 1.30 provided within [* * *] of Novo's designation. Promptly after Dicerna designates the proposed Dicerna Reserved Orphan Liver Target as a Co-Development Product, the Parties shall negotiate in good faith and enter into a written agreement for co-promotion setting forth the terms of Dicerna's and Novo's rights and obligations with regard to such co-promotion in accordance with Exhibit G and the terms and conditions in this Agreement. This election by Dicerna shall be in addition to Dicerna's rights to designate two Co-Development Products in Section 2.3.3.

(d) If Novo challenges the status of such proposed Dicerna Reserved Orphan Liver Target as one for which an Orphan Liver Indication is the sole disease in the Field for which the proposed Dicerna Reserved Orphan Liver Target could be relevant in accordance with the foregoing Section 2.3.2(a)(i), such dispute shall be resolved in accordance with the procedures set forth in Section 19.5. If such dispute resolution procedures result in a determination that the proposed Orphan Liver Indication was validly proposed by Dicerna, Section 2.3.2(b) shall apply (inclusive of Novo's ongoing option under Section 3.3) as if Novo never provided notice challenging the designation. If such dispute resolution procedures result in a determination that the proposed Dicerna Reserved Orphan Liver Target was not validly proposed by Dicerna, such proposed Target shall remain a Target available for designation as a Collaboration Target hereunder.

(e) If Dicerna is researching, developing and commercializing a compound or product Directed To a Dicerna Reserved Orphan Liver Target under Section 2.3.2(b), and if there is any indication other than an Orphan Liver Indication that is relevant for the Dicerna Reserved Orphan Liver Target, then neither Dicerna nor its Affiliates, licensees and transferees shall, unless otherwise agreed to in writing by Novo in its sole discretion, Research, Develop or Commercialize any compound or product Directed To the Dicerna Reserved Orphan Liver Target for such other non-Orphan Liver Indication. In such event, Dicerna shall notify Novo and the Parties will discuss research, development and commercialization of such non-Orphan Liver Indication and consider adding it to the Agreement as a Collaboration Target and Co-Development Target.

2.3.3 Dicerna Options for Co-Development and Co-Promotion.

(a) During the R&D Collaboration Term of this Agreement, Dicerna shall have an option to designate a total of [* * *] Products as Co-Development Products that, upon such designation, will become subject to Section 5.4. For purposes of clarity, any such designation shall apply to all indications for the applicable Product. Dicerna has an option to select [* * *] Product as a Co-Development Product upon availability of top-line data from the first Phase 1 Clinical Trial (referred to in this Section 2.3.3 as "completion" of the first Phase 1 Clinical Trial) for such Product and one (1) Product as a Co-Development Product upon availability of top-line data from the first Phase 2 Clinical Trial (referred to in this Section 2.3.3 as "completion" of a Phase 2 Clinical Trial) for such Product, in each case provided that Dicerna exercises such option within the time period specified in Section 2.3.3(b) below. For purposes of clarity, the first Product chosen by Dicerna as a Co-Development Product may be designated as such upon either such completion, but the second Product chosen by Dicerna as a Co-Development Product may only be designated as such at the point in time not used by Dicerna to choose the [* * *] Product (i.e., [* * *] Product may be designated as a Co-Development Product following completion of the first Phase 1 Clinical Trial and [* * *] Product may be designated as a Co-Development Product upon completion of the first Phase 2 Clinical Trial). During the R&D Collaboration Term, for each Product, Novo will deliver to Dicerna within [* * *] of completion of the first Phase 1 Clinical Trial and the first Phase 2 Clinical Trial, in each case only if Dicerna retains a designation option at such point in time: (a) a reasonably detailed and complete report and analysis of the Phase 1 Clinical Trial or Phase 2 Clinical Trial, as applicable; and (b) a proposed budget detailing projected expenses for the remainder of the Development of such Product through the first Marketing Authorization thereof in the first Major Territory. Dicerna may select such Product as a Co-Development Product until [* * *] from Dicerna's receipt from Novo of the foregoing by providing a written notice stating that it wishes to designate such Product as a Co-Development Product and specifying a Co-Development Percentage in accordance with Section 1.30.

(b) If Dicerna exercises its option to designate a Co-Development Product, then Dicerna also shall have the option to co-promote the Co-Development Product in the United States for the same percentage of details as its designated Co-Development Percentage. Approximately [* * *] before the anticipated filing of the first Marketing Authorization for a given Co-Development Product, Novo shall deliver and discuss with the JSC the applicable Commercialization Plan. In addition to information received through the JSC, Dicerna may submit written questions to Novo about the Commercialization Plan for such Co-Development Product within [* * *] of the receipt of such information, in which case Novo will respond to such questions no later than [* * *] from receipt of Dicerna's questions. Dicerna may exercise its option by giving written notice thereof to Novo no later than [* * *] following Novo's delivery to the JSC of the applicable Commercialization Plan. If Dicerna fails to provide such written notice within such time period, Dicerna's option is of no further force or effect. Promptly after Dicerna exercises a co-promotion option for a Co-Development Product, the Parties shall negotiate in good faith and

enter into a written agreement for co-promotion setting forth the terms of Dicerna's and Novo's rights and obligations with regard to such co-promotion in accordance with Exhibit G and the terms and conditions in this Agreement. For the avoidance of doubt, the contents of each Commercialization Plan for each Co-Development Product designated by Dicerna, and any amendments to each such Commercialization Plan, are at all times within the sole discretion of Novo, and neither the JSC nor Dicerna has any right to approve or amend any such Commercialization Plan, regardless of whether Dicerna exercises its option to co-promote.

2.3.4 Continuation Targets. During the R&D Collaboration Term, Novo may provide written notice to the JSC and Dicerna designating up to [* * *] Targets among the Collaboration Targets (including Validated Targets) as "**Continuation Targets**" which will remain available to Novo and subject to the exclusivity provisions of Sections 3.1 and 3.2 for a period ending on the earlier of [* * *] after the completion of the R&D Collaboration Term or [* * *] after the Effective Date. For the avoidance of doubt, once a Collaboration Target is designated as a Continuation Target, it is still considered a Collaboration Target subject to this Section 2.3.4.

2.3.5 Discontinued Targets. On a Collaboration Target-by-Collaboration Target basis, upon the later of the end of all Novo Review Periods or the end of the R&D Collaboration Term, the remaining Collaboration Targets that are not (i) Validated Targets for which a Development Candidate has been nominated or (ii) Continuation Targets, shall become Discontinued Targets, subject to Section 15.2. At the end of the period ending on the earlier of [* * *] after the completion of the R&D Collaboration Term or [* * *] after the Effective Date, any Continuation Target for which a Development Candidate has not been nominated shall become a Discontinued Target.

2.4 Gatekeeper Process.

2.4.1 Gatekeeper. The Parties have agreed to use an independent attorney to act as an information gatekeeper (the "**Gatekeeper**") through which Novo may directly inquire as to whether any Target that Novo intends to designate as a Collaboration Target (whether pursuant to Section 2.1 or Section 2.4) is a Blocked Target at that time; Dicerna may inquire as to whether any Hepatocyte Target is available to be a Dicerna Reserved Orphan Liver Target or a Blocked Target pursuant to Section 1.18(iv) and Dicerna's third party partners (i.e., Alexion, Lilly, Roche and BI) may inquire as to whether any Target is available to be designated as a Blocked Target at that time. Dicerna and Novo will cause the Gatekeeper to enter into a customary confidentiality agreement that includes confidentiality obligations at least as stringent as the provisions set forth in Article 10 and prohibits the Gatekeeper from disclosing to Novo the Blocked Targets List or from disclosing to either Dicerna or Novo the identity of a Target that was the subject of any inquiry by the other Party. Nothing in this Section 2.4.1 will preclude Novo from contacting Dicerna directly regarding the availability of Targets or otherwise, to which Dicerna will respond in its discretion, or preclude Dicerna from contacting Novo directly regarding whether a particular Target is a Collaboration Target. The initial Gatekeeper will be [* * *], whom the Parties have acknowledged and agreed is independent and which law firm shall enter into an agreement regarding the continued independence

of such Gatekeeper. As of the Effective Date, the Gatekeeper has confirmed and reserved certain Pre-Reserved Targets for designation as Collaboration Targets hereunder.

2.4.2 Gatekeeper Procedures. At the Signing Date Dicerna shall provide to the Gatekeeper the list of Blocked Targets for the Dicerna Excluded Programs and from time to time thereafter (including at least [* * *], including in response to inquiries hereunder), (a) Dicerna will provide the Gatekeeper with a current list adding up to [* * *] Dicerna Reserved Orphan Liver Targets which shall be Blocked Targets (where it is understood that [* * *] such Targets is all Dicerna may designate during the R&D Collaboration Term pursuant to this Agreement) (the "**Blocked Target List**"), and (b) Novo will be entitled, acting in good faith as reasonably necessary to identify Hepatocyte Targets as permitted under Section 2.1.1, to submit inquiries to the Gatekeeper as to whether or not a proposed Target is a Blocked Target. Upon receipt of an inquiry, the Gatekeeper will notify Dicerna of such inquiry by Novo without disclosing the proposed Target, after which Dicerna will have [* * *] to provide the Gatekeeper with any updates on requests made to Dicerna for reservations, substitutions or eliminations to the Blocked Target List with supporting evidence of such changes having been requested in writing prior to the Novo inquiry. The Gatekeeper will inform Novo in writing whether the proposed Target is a Blocked Target within [* * *] of receipt of the associated inquiry and, if the proposed Target is a Target as to which Dicerna can still grant rights to Novo, the Gatekeeper will inform Novo of the availability of such Target and what rights Dicerna can grant and any associated restrictions. Upon the Effective Date, the Pre-Reserved Targets will automatically be designated as Collaboration Targets and after the Effective Date upon notification of Novo by the Gatekeeper of availability, each subsequent proposed Target will be automatically designated as Collaboration Targets. If the Gatekeeper notifies Novo in response to an inquiry (or Dicerna notifies Novo, in the case of direct contact between the Parties) that a proposed Target is a Blocked Target, Novo will not have exhausted any of its rights to reserve or select Targets as a result of the inquiry, and if the status of any Blocked Target changes and it is no longer a Blocked Target, Dicerna shall promptly notify the Gatekeeper; and if such a change relates to a Target which was previously submitted by Novo and rejected by the Gatekeeper, the Gatekeeper shall be under an obligation to notify Novo of such change as soon as practicable. Dicerna may from time to time inquire as to whether any Hepatocyte Target with respect to which Dicerna intends to engage in activities that may be restricted under Sections 3.1 and 3.2 is a Collaboration Target. Upon receipt of such an inquiry from Dicerna, the Gatekeeper will inform Dicerna in writing whether the proposed Target is a Collaboration Target within [* * *] of receipt of the associated inquiry.

2.5 Scope of Blocked Targets. [* * *].

2.6 Encumbered Targets [* * *].

3. EXCLUSIVITY

3.1 Hepatocyte Target Exclusivity – [* * *]. [* * *], with respect to each Hepatocyte Target that is not a Blocked Target, except as agreed in the Research Plan or as mutually agreed to by the Parties, Novo shall have exclusive and, as applicable, co-exclusive worldwide rights to Research, Develop and Commercialize Compounds and Products in the Field, and Dicerna shall be exclusive to and work exclusively with Novo on Researching, Developing or Commercializing Compounds or Products Directed To any such Hepatocyte Target in the Field. In connection with

the foregoing, other than as may be incidental to research activities for Blocked Targets, and except as may be permitted under Section 19.1 or as Dicerna may be permitted to delegate its obligations to a Permitted Subcontractor pursuant to Section 4.8, Dicerna shall not (by itself nor with any Third Party) and shall cause its Affiliates not to (by themselves nor with any Third Party) and shall not grant rights to any other Third Parties, carry out Research, Development or Commercialization, of any Hepatocyte Target that is not a Blocked Target, nor sell, assign, transfer, convey, license, sublicense, covenant not to assert or otherwise grant or transfer, to any Third Party (other than to an assignee pursuant to Section 19.1), any rights or immunities to or under any Licensed Patent Rights to carry out any of the foregoing activities. In addition, during the [* * *], with respect to each Collaboration Target, subject to Dicerna's rights under Sections 2.3.2 and 2.3.3, Dicerna shall not enter into any agreement or take any action that would adversely affect its ability to extend Novo the rights granted hereunder and otherwise perform should such Collaboration Target be selected as a Validated Target.

3.2 Development Candidate and Product Exclusivity - Term of Agreement, During the Term of this Agreement, with respect to each Development Candidate or Product, except as agreed in the Development Plan or as mutually agreed to by the Parties in writing, Novo shall have exclusive and, as applicable, co-exclusive worldwide rights to Develop and Commercialize Development Candidates and Products in the Field, and Dicerna shall be exclusive to and work exclusively with Novo on the Research, Development and Commercialization of all such Development Candidates or Products Directed To a Collaboration Target in the Field while Novo is researching or developing any Development Candidates or Products Directed to such Collaboration Target and Dicerna shall be exclusive to and work exclusively with Novo on any Commercialization of all such Development Candidates or Products Directed to a Collaboration Target in the Field while Novo is commercializing a Development Candidate or Product Directed to such Collaboration Target. In connection with the foregoing, other than as may be incidental to research activities for Third Party products not Directed To the applicable Collaboration Target, and except as may be permitted under Section 19.1 or as Dicerna may be permitted to delegate its obligations to a Permitted Subcontractor pursuant to Section 4.8, Dicerna shall not (by itself nor with any Third Party) and shall cause its Affiliates not to (by themselves nor with any Third Party) and shall not grant rights to any other Third Parties, to (i) during such Development by Novo, carry out Development or Commercialization, and (ii) during such Commercialization by Novo, carry out Commercialization in the case of each (i) and (ii), of any compound, product, or therapy containing anything that binds to, or is intended to bind to, the same Validated Target in the Field to which such Development Candidate or Product is Directed To, nor sell, assign, transfer, convey, license, sublicense, covenant not to assert or otherwise grant or transfer, to any Third Party (other than to an assignee pursuant to Section 19.1), any rights or immunities to or under any Licensed Patent Rights to carry out any of the foregoing activities.

3.3 [* * *].

3.4 Limited Novo Exclusivity. If during the Discovery Period, Novo wishes to Research, Develop or Commercialize, by itself or any Affiliate or Third Party, any compound, product or therapy using siRNA conjugated to GalNAc that is Directed To a Collaboration Target in the Field and Novo had not already commenced any such research prior to the Signing Date,

such Research, Development or Commercialization shall be done in collaboration with Dicerna under this Agreement and subject to the confirmation of availability through the Gatekeeper process described in Section 2.5. Otherwise, nothing in this Agreement shall restrict the ability of Novo or its Affiliates to research, develop or commercialize any compounds, products or therapies, it being understood that this Section 3.4 shall not be deemed to expand the scope of any licenses to Licensed Technology or ownership or Control of intellectual property granted hereunder.

3.5 Blocked Targets and Third Party Agreements. [* * *].

4. RESEARCH AND PRODUCT DEVELOPMENT

4.1 Research and Development Program.

4.1.1 Purpose. During the R&D Collaboration Term, Dicerna and Novo shall engage in a research and development program with the goal of Researching and Developing one or more Compounds from which one or more Development Candidates would be nominated by the JSC or Novo for further Development as Compounds or Products based on the specified activities, timelines and criteria set forth in the Work Flow Plan and/or an applicable Research Plan or Development Plan (such research and development program, the "**R&D Program**"). Each of the Parties shall expend at least the resources specified in the Work Flow Plan in the performance of its Research and Development activities during R&D Collaboration Term.

4.1.2 R&D Collaboration Term. The R&D Program shall be conducted over a term commencing on the Effective Date and continuing for a period of [* * *] thereafter (the "**Initial R&D Collaboration Term**"), provided that with respect to any particular Collaboration Target that is the subject of active Development at the end of the Initial R&D Collaboration Term, the term shall be extended for an additional [* * *] period(s) if Proof of Principle has not been achieved by the Parties on at least [* * *] Compounds following designation of at least [* * *] Collaboration Targets and provided that such lack of achievement has not been caused by Novo's failure to perform its obligations under the Research Plan, if any, or if the Parties mutually agree in writing that additional time is needed to complete Research and Development toward the nomination of Development Candidates (the Initial R&D Collaboration Term plus any such extensions, the "**R&D Collaboration Term**").

4.1.1 Work Flow Plan. All Research and Development activities of each Party occurring during the R&D Collaboration Term and the timelines for all Collaboration Targets and Products therefor shall be set forth in the Work Flow Plan set forth in Exhibit A attached hereto.

4.1.2 Research and Development Plans. All Research and Development activities occurring during the R&D Collaboration Term and the timelines and budget for all Collaboration Targets and Products therefor shall be set forth in one or more mutually agreed upon research plans (each, a "**Research Plan**") or Development Plans, copies of which will be signed and furnished to each Party, subject to Section 4.1.3, as may be amended from time to time in accordance with the terms of this Agreement. Once agreed upon, the first Research Plan hereunder shall be attached hereto as Exhibit B. For clarity, subject to Section 4.1.3, the budgets to be set forth in the Research Plan(s) shall be construed only as guidelines and shall not in any way limit a

Party's obligations to use Commercially Reasonable Efforts to perform all activities specified in the Research Plan, subject to the rights of reimbursement and any limitations on responsibilities or their costs as expressly set forth in this Article 4. Each Target and Compound shall have a separate Research Plan and Development Plan associated with it unless otherwise agreed to by the Parties (e.g. because a Target is dual or Targets are interdependent). For the avoidance of doubt, Novo's Research and Development activities shall not be constrained by the contents of any Research Plan or Development Plan.

4.2 Research and Development Activities.

4.2.1 Activities until Achievement of Proof of Principle. For each Validated Target, Dicerna shall use Commercially Reasonable Efforts to conduct activities specified in the Research Plan directed toward the achievement of Proof of Principle of a Compound Directed To that Validated Target Each Party is responsible for its own expenses in conducting activities specified in the Research Plan and intended for achieving Proof of Principle, which in Dicerna's case, may include rodent and non-human primate studies before Proof of Principle but no other *in vivo* studies, unless otherwise discussed and agreed by the JSC. Notwithstanding the foregoing, subject to Novo's prior written approval regarding the costs thereof, Novo shall be responsible for reimbursing reasonable, out-of-pocket costs paid by Dicerna to Third Party contract manufacturers for CMC Activities to support animal studies that are reasonably necessary to achieve Proof of Principle.

4.2.2 Activities from DC Nomination through IND Submission. For the first Development Candidate nominated by the JSC or Novo, Dicerna shall use Commercially Reasonable Efforts to conduct all activities specified in the Development Plan that are not expressly indicated as being Novo's responsibility in a manner reasonably requested by Novo toward the preparation and submission of an IND for the Development Candidate with Novo having the sole obligation for payment of related expenses after nomination as a Development Candidate for the applicable Validated Target, provided further that Novo will only be responsible for payment of expenses incurred in accordance with a Development Budget that has been approved in writing by Novo, including Dicerna's Direct Manufacturing Costs from and after achievement of Proof of Principle that have been so approved. Novo shall use Commercially Reasonable Efforts to perform such activities specified in the Development Plan that are expressly indicated as Novo's responsibility. For all subsequent Development Candidates nominated by the JSC, unless otherwise agreed to by the Parties, Novo shall use Commercially Reasonable Efforts to conduct activities it deems reasonably appropriate in furtherance of the preparation and submission of an IND for each subsequent Development Candidate.

4.3 Clinical Development Activities. Subject to Section 3.1, Novo shall use Commercially Reasonable Efforts to conduct all Development activities from IND Approval through Commercialization on at least [* * *] Development Candidates, provided that at least [* * *] Development Candidates are selected for Development Candidate nomination. If more than [* * *] Development Candidates are selected, then Novo shall, subject to the immediately preceding sentence, have the right to prioritize its Development efforts among such Development Candidates.

4.1 Costs of Performance.

4.1.1 Responsibilities of Parties.

(a) Except as otherwise expressly set forth in this Agreement or in a Research Plan, during the Term, each Party shall bear its expenses conducting Research activities until nomination as a Development Candidate for a Compound Directed To a Validated Target.

(b) [* * *].

(c) [* * *].

(d) Except as otherwise set forth in herein, unless the Parties mutually agree or subject to Sections 2.3.2, 2.3.3, 3.3 or 5.4, [* * *] will not bear any expenses after nomination as a Development Candidate for a Compound or Product and [* * *] shall bear all other expenses incurred under this Agreement, including for Development and Commercialization, other than for a Co-Development Program.

4.1.2 Cost Calculation Mechanism. Where this Agreement expressly requires that Novo reimburse or be responsible for Dicerna's expenses incurred under a Research Plan or Development Plan or otherwise directed by Novo under Section 4.2.2, such expenses shall be calculated in accordance with the following mechanism: Novo shall compensate Dicerna for FTEs performing activities under and in accordance with the Research Plan or Development Plan at the FTE Rate, provided that the nature and scope of the work performed by Dicerna has been approved in advance in writing by Novo and that Dicerna uses at least the same level of efforts and efficiency to perform such work as Dicerna uses for similar work performed for its own account (but in no event less than Commercially Reasonable Efforts). For the avoidance of doubt, the FTE Rates are payable solely for activities for which this Agreement expressly specifies that Novo is to reimburse or be responsible for Dicerna's expenses and are not payable for any other activities that Dicerna undertakes. In addition to the FTE Rates, Novo shall reimburse any out of pocket expenses incurred by Dicerna in accordance with the Research Plan or Development Plan that are specified as being Novo's responsibility. The compensation is to be paid by Novo to Dicerna on a [* * *] basis with respect to each [* * *]. Payment shall be made in arrears and within [* * *] after receipt of an invoice, with supportive documentation detailing the FTE hours and out of pocket expenses applicable to Dicerna's efforts for such applicable [* * *] period, such information to include the work packages of the Development Plan items worked on the number of FTEs assigned to each work package and the out-of-pocket expenses. Notwithstanding the foregoing, contract research organization ("**CRO**") expenses incurred by Dicerna in accordance with the Development Plan shall be invoiced separately by Dicerna upon Dicerna's receipt of such CRO's invoice, and irrespective of whether such payments are made in advance or in arrears, such invoice to be due and payable within [* * *] upon receipt of such invoice by Novo; provided, that, if Novo reimburses Dicerna for advance payments made by Dicerna to CROs, Dicerna shall provide the final actual cost per invoiced period and a true up of actual cost compared to advance payment (planned cost) to Novo. If the advance payment(s) turn out to be higher than the actual cost incurred by Dicerna,

Dicerna shall credit the respective amount of the advance payment to the next invoice or invoices payable by Novo, and in the event there are no further invoices anticipated, reimburse Novo within [* * *] of such true up. As long as Dicerna provides Development support to Novo and for a period of [* * *] thereafter, Dicerna shall maintain complete and accurate books and records regarding the FTEs and all out-of-pocket expenses (including CRO expenses) invoiced to Novo and Novo shall have the right to have an Accounting Firm inspect Dicerna's records solely for purposes of determining the accuracy of the FTEs passed through to Novo in accordance with Section 9.5 of this Agreement applied *mutatis mutandis* (subject only to replacing references to "Novo" with references to "Dicerna," and *vice versa*, and other analogous changes, including changes related to the subject matter of the audit). Unless mutually agreed to by the parties, Dicerna shall invoice Novo for such expenses according to the Novo Nordisk A/S Invoicing Instructions attached hereto as Exhibit C.

4.2 IND Filing. For all Products Developed and Commercialized under Section 4.2 or Section 4.3**,** [* * *], Novo shall be responsible for the preparation and submission of the IND filing and for seeking IND Approval and shall have control over all interactions with the applicable Regulatory Authority. [* * *], the Parties shall be jointly responsible for the preparation and submission of the IND filing, including responses to any questions from the Regulatory Authorities during review, at Novo's expense, but Novo will otherwise be responsible for seeking IND Approval and shall have control over all interactions with the applicable Regulatory Authority. Novo shall own all Regulatory Approvals and be responsible for all decisions in connection therewith for Regulatory Approvals of Products in the Field; provided, that Dicerna shall reasonably cooperate in these efforts as reasonably requested by Novo at Novo's expense.

4.3 Records, Reports and Audits.

4.3.1 Records of Activities under R&D Program. Dicerna and Novo shall maintain complete, current and accurate records (paper and/or electronic) for so long as necessary to comply with Applicable Laws, or reasonably necessary to support the prosecution, maintenance and enforcement of intellectual property rights (including Patent Rights), regarding its conduct of the R&D Program after the applicable activity, in sufficient detail and in good scientific manner appropriate for patent and regulatory purposes, which shall fully and properly reflect the work done and results achieved by each Party in the performance of the R&D Program; and sufficient to confirm the accuracy and contents of the Blocked Target List (the "**Records**"). Electronic Records shall be stored by each Party in accordance with the system for electronic data storage and exchange specified by the JSC (which specification the JSC shall agree upon during the first JSC meeting).

4.3.2 Prioritization and Resource Allocation Planning. At the Effective Date and at least [* * *] thereafter, Dicerna will present to the JSC for approval a proposed project prioritization and timeline for the next [* * *] period, including a suggested allocation of FTE resources to each identified Collaboration Target; provided that, if the JSC is unable to agree on such project prioritization, timeline and/or allocation of resources, including FTEs, such issue(s) shall be finally decided as set forth in Section 19.6. Dicerna shall provide to Novo a draft of the above project prioritization and timeline at least [* * *] in advance of the JSC meeting at which such project prioritization and timeline is to be discussed.

4.3.3 Resource Allocation. During the R&D Collaboration Term, Dicerna and Novo agree that each will assign to the Collaboration Targets resources substantially in accordance with the budgets set forth in the Research Plans, including appropriate personnel resources comprising skills and levels of experience consistent with such budgets set forth in the Work Flow Plan.

4.3.4 Copies and Inspection of Records. [* * *].

4.4 Certain Standards Applicable to Work.

4.4.1 All Research and Development done by either Party for non-regulated work under this Agreement will be conducted in accordance with the Research Plan or Development Plan, all applicable data privacy and security laws and regulations and other Applicable Laws. [* * *].

4.4.2 [* * *]. [* * *]. Each Party represents and warrants that, during the R&D Collaboration Term, it shall adhere to and comply with its respective obligations related to the use of [* * *] set forth in Exhibit L and shall use Commercially Reasonable Efforts to ensure that all future subcontractors and CROs adhere to and comply with these obligations. The decision to use [* * *] in the activities to be conducted pursuant to the Research Plan or Development Plan shall be made by the JSC.

4.4.3 Use of Animals. The Parties agree to ensure high welfare standards for experimental animals used in any activities to be conducted pursuant to the Research Plan or Development Plan. Dicerna acknowledges that it has read and understood Novo's Principles for the Use of Animals attached hereto as Exhibit M and agrees to adhere to and comply with these obligations. Dicerna must promptly notify Novo in the event of any material unexpected issues in relation to animal welfare or bioethical concerns that occur under the Research Plan or Development Plan and Dicerna must report to Novo the number of experimental animals having been used by Dicerna under the Research Plan or Development Plan in a [* * *] within [* * *] after the end of such [* * *]. The Parties agree to reasonably collaborate to address any such issues and concerns to the extent such issues and concerns relate to more than local legal requirements. Dicerna acknowledges that Novo may require a single on-site animal welfare inspection prior to initiation of the activities to be conducted pursuant to the Research Plan or Development Plan. If Novo wishes to perform such animal welfare inspection during the R&D Collaboration Term, Dicerna shall give Novo access to the relevant areas of its site upon reasonable notice of no less than [* * *]; provided, that any such audit shall comply with Dicerna's SPF protocols, shall not be conducted more than [* * *] (except in the event that an audit identifies any issues, in which case Novo shall be permitted to undertake a follow-up audit) and shall be conducted during normal business hours and in a manner intended to minimize any disruptions to Dicerna's day-to-day business.

4.5 Right to Subcontract. Subject to the terms of this Section 4.8 and Section 5.1.2, each Party shall have the right to engage permitted Third Party contractors working on its behalf (the "**Permitted Subcontractors**") to perform such portions of its Research and Development obligations under this Agreement that it customarily engages for its other similar research and Development activities, except that: (a) any use of Permitted Subcontractors by Dicerna is subject

to the prior written approval of Novo, except for the contract manufacturers listed on Exhibit I; and (b) under no circumstance can such Permitted Subcontractor be debarred or disqualified by a regulatory authority. Any Permitted Subcontractor to be engaged by a Party to perform its obligations under this Agreement shall meet the qualifications typically required by such Party for the performance of work similar in scope and complexity to the subcontracted activities. Furthermore, notwithstanding the foregoing, each Party shall be responsible for ensuring that, prior to engaging any Permitted Subcontractor that such Permitted Subcontractor is subject to written agreements containing terms and conditions: (i) consistent with and which provides a substantially similar degree of protection as the relevant terms and conditions of this Agreement protecting the rights of the Parties under this Agreement including imposing obligations of confidentiality on each such Permitted Subcontractor; (ii) that vests ownership in such Party of any and all Inventions developed by such Permitted Subcontractor in the course of performing such subcontracted work; (iii) that does not under any circumstance impose any payment obligations or liability on the other Party, and (iv) that is otherwise consistent with the terms of this Agreement. Dicerna shall obtain the right for Novo to once annually and at its own expense to audit Permitted Subcontractors of Dicerna in accordance with Section 4.6.4. Each Party shall remain directly responsible for all of its obligations under this Agreement that have been subcontracted or sublicensed to any Permitted Subcontractor.

5. MANUFACTURING AND COMMERCIALIZATION

5.1 Compound and Product Manufacturing Generally.

5.1.1 Generally. Dicerna shall supply Compounds through nomination as a Development Candidate in accordance with Section 5.1.2, either itself or through a contract manufacturer disclosed pursuant to Section 5.1.2. Subject to the Parties' respective rights and obligations with respect to filing applications for and obtaining IND Approvals as set forth in Sections 4.2.2 and 4.5, Dicerna has the right to perform and manage the CMC Activities through IND Approval, and the obligation to do so, [* * *]. On a Development Candidate-by-Development Candidate basis, the Parties, in consultation with the JSC, shall decide on the transfer of responsibilities and obligations related to CMC. The Parties will specify in the relevant Research Plan or Development Plan the source of manufacture and supply of all other pre-clinical and clinical Products. For the avoidance of doubt, unless the Parties mutually agree to other terms, Dicerna will have no obligation to Manufacture any Compounds or Products for Clinical Trials and will not be responsible for any Manufacturing Expenses after nomination as a Development Candidate. If the Parties mutually agree that Dicerna will supply Products for Clinical Trials, the Parties will negotiate in good faith a future Supply Agreement for submission to the JSC for approval.

5.1.2 Manufacturing Standards. A list of the contract manufacturers that Dicerna has engaged with the ability to Manufacture the Products for Research and Development until at least IND-submission (on a Product-by-Product basis) is attached as Exhibit I, which contract manufacturers shall be considered Permitted Subcontractors in accordance with Section 4.8. Without limiting the foregoing, but subject to the terms and conditions of this Agreement, the Parties will negotiate in good faith to come to a mutual agreement related to Product supply by Dicerna under GMP during the R&D Collaboration Term for each Product up until nomination as a Development Candidate and, with the respect the first Product that is the subject of an IND filing,

up until such IND filing; it being understood that unless the Parties agree otherwise, Dicerna has the right to use the contract manufacturers in Exhibit I to fulfill its manufacturing obligations. The Parties shall enter into a quality agreement if Novo determines that such an agreement is relevant to the conduct of manufacturing activities. When Dicerna uses a contract manufacturer or other subcontracted element of the supply chain, Novo will have the right to audit such contract manufacturer and to approve (or reject) in advance any new contract manufacturer that is not listed on Exhibit I, provided that such approval shall not be unreasonably withheld, delayed or conditioned. The Parties agree that the manufacturers for each Product shall be listed in the Research Plan or Development Plan. Except as set forth in this Section 5.1.2, Novo shall have the right to perform or have performed Product manufacturing in its discretion.

5.1.1 Visits to Facilities. Novo may conduct ongoing and routine audits of Dicerna or its subcontractors (including its contract manufacturers) in accordance with Section 4.6.4 (including the expense reimbursement provisions thereof) to ensure compliance with applicable GMPs and Exhibit M during normal business hours no more than once annually and upon reasonable advance notice by Novo and the mutual agreement of the Parties as to the specific date and time for such audit, provided, however, that in the case of audits for cause, Novo will have the right to conduct, or cause Dicerna to conduct, compliance audits more than once annually at the time of the event giving rise to a for cause audit, upon at least [* * *] advance written notice, provided that such audit does not unreasonably interfere with Dicerna's operations. Dicerna shall ensure that all of its agreements with is contract manufacturers and other subcontractors provide for Novo to directly conduct such audits.

5.1.1 Notice of Inspections. If legally permissible, Dicerna shall provide notice to Novo within [* * *] of becoming aware of any requested or commenced governmental or regulatory review, audit or inspection of its or its contractor's facility, processes, Compounds or Products that directly relate to this Agreement. Dicerna shall provide Novo with the results of any such review, audit or inspection and be given the opportunity to provide assistance in responding to any such review, audit or inspection.

5.2 Product Quality Generally. An applicable quality agreement will determine, in accordance with applicable regulatory requirements, all Product quality standards for Product to be used in Clinical Trials including: stability; process validation and pre-approval inspection preparation; specifications; assay methodology and storage conditions. Novo will determine in accordance with applicable Regulatory Requirements such Product quality standards that must be included in any manufacturing requirements for Product and Novo will in all circumstances have the sole right to make the final release determinations for the Products, as the Parties shall set forth greater detail in the applicable quality agreement.

5.3 Commercialization by Novo. Subject to Sections 2.3.2, 2.3.3, 3.3 and 5.4, Novo shall have the sole right and be responsible for Commercialization of the Products in the Territory, and shall use Commercially Reasonable Efforts to achieve a First Commercial Sale of at least [* * *] Products, provided that all necessary Regulatory Approvals are obtained.

5.4 Co-Development Payments. A Co-Development Program will not be subject to any future Development and Regulatory Milestone Payments, Commercial Milestone Payments or

Royalties due under Sections 8.4, 8.5 and 8.6. Upon Dicerna's designation of a Product as a Co-Development Product, all Development and Regulatory Milestone Payments and Commercial Milestone Payments previously paid by Novo to Dicerna with respect to such Product and the relevant Collaboration Target shall constitute Pre-Option Development Expenses of Novo and be subject to Section 5.4.2 below.

5.4.1 Budget. On a Co-Development Program-by-Co-Development Program basis, and as further detailed in Exhibit F, the Parties will promptly agree upon a budget for expected Development Expenses for the Co-Development Program ("**Co-Development Budget**") unless the Parties have already agreed upon or the JSC has determined a Development Budget, which will be used to calculate the Co-Development Budget. [* * *].

5.4.2 Payment of Shared Costs and Profits. Subject to Section 5.4.1 and as further detailed in Exhibit F, the designating Party will be responsible for: (i) paying the other Party for all Co-Development Pre-Option Expenses within [* * *] of the receipt of an invoice from the non-designating Party issued on or after the designation date; and (ii) payment of Co-Development Post-Option Expenses as they are incurred for a given Co-Development Program within [* * *] after receipt of a report of Co-Development Post-Option Expenses incurred by the other Party, which report shall be submitted following the end of each [* * *] beginning with the [* * *] of opt-in. Each Party will be entitled to a respective percentage of Global Profits for the Co-Development Product, with the designating Party receiving an amount equal to Co-Development Percentage multiplied by Global Profits ("**Co-Development Profit Share**") and the Party responsible for Commercialization activities receiving the remainder of Global Profits, as further detailed in Exhibit F. In the event that actual Co-Development Post-Option Expenses for a [* * *] exceed the Co-Development Budget in effect as of the first day of such [* * *] by more than [* * *]:

(a) Dicerna may (but is not required to) elect, upon written notice to Novo delivered within [* * *] of the date on which Novo notifies Dicerna of such budget excess, to continue to pay the budgeted Co-Development Post-Option Expenses and adjust the future Co-Development Percentage to reflect the relative share paid by each Party of the Co-Development Post-Option Expenses for the Product. By way of example, if (i) Dicerna's Co-Development Percentage is [* * *], (ii) in prior [* * *], the aggregate Co-Development Post-Option Expenses were [* * *] (of which Dicerna paid [* * *]), (iii) the Co-Development Budget for the Product in the current [* * *] is $[* * *] (of which Dicerna's share would be ([* * *]), and (iv) FDA requires an additional arm be included in a Pivotal Study and, as a result, the actual Co-Development Post-Option Expenses incurred during such [* * *] (including the additional Co-Development Post-Option Expenses for such additional arm) totaled [* * *], Dicerna could elect to pay only [* * *] (i.e., [* * *] of its budged share) and to decrease its Co-Development Percentage going forward to [* * *] (calculated as [* * *] (i.e., the aggregate Co-Development Post-Option Expenses funded by Dicerna through such [* * *])) divided by [* * *] (i.e., the total Co-Development Post-Option Expenses through such [* * *])). Once Dicerna makes such an election, Dicerna may not thereafter increase its Co-Development Percentage; or

(b) Dicerna may (but is not required to) elect, which election Dicerna may make only once during the Term, upon written notice to Novo delivered within [* * *] of the date on which Novo notifies Dicerna of such budget excess, to defer its portion of such excess Co-Development Post-Option Expenses over [* * *] of the budgeted Co-Development Budget for the Product in the current [* * *], with the amount of such deferral not to exceed a total [* * *]. For example, in the circumstances described in the example in Section 5.4.2(a) above, Dicerna could elect to defer [* * *] (i.e., [* * *] of the portion of the budget excess ([* * *]) over [* * *] of the Co-Development Budget for the Product in the current Calendar Year). The deferred amount must be repaid within the following [* * *] immediately subsequent [* * *] with an interest rate of [* * *].

5.4.3 Co-Development Product Payments. Subject to this Section 5.4, with respect to each Co-Development Product, Global Profits accrued during the Term shall be shared between the Parties according to the Co-Development Profit Share, except as subject to Section 5.4.4. Within [* * *] after the end of each [* * *], the Party responsible for such Commercialization shall submit a report to the other Party, including a calculation of Net Sales during such Calendar Quarter, a breakdown of the calculation of Global Profits, and a proposed division between the Parties, including the calculation of Co-Development Profit Share, in accordance with Section 5.4.2. Concurrently with the submission of such report, the Party responsible for such Commercialization shall make a payment to the other Party in an amount calculated according to the Co-Development Profit Share included in such report; provided, however, that in the event such calculated payment amount is negative (including all previous calculated payment amounts that were negative), the Party responsible for such Commercialization shall invoice the other Party for such amount and the other Party shall pay on such invoice within [* * *] of the date thereof. In the event of any disagreement with respect to the calculation of such payment, any undisputed portion of such payment shall be paid in accordance with the foregoing timetable and the remaining, disputed portion shall be paid within [* * *] after the date on which the Parties, using good faith efforts, resolve the dispute.

5.4.4 Failure to Pay and Early Termination. If a designating Party fails to make timely and complete payment of the Co-Development Pre-Option Expenses or any Co-Development Post-Option Expenses, the other Party may provide written notice of termination of the relevant Co-Development Program to the designating Party, which notice shall be effective [* * *] after the date of the notice unless the failure to pay is cured within such time period. If a Co-Development Program is terminated, the underlying Co-Development Target will become a Collaboration Target. In the event of any such termination with respect to a Co-Development Program that had been designated by Dicerna, Dicerna shall not be eligible to receive any payments under Sections 8.2 or 8.3 with respect to any applicable Products. For the avoidance of doubt, no payments are due under Sections 8.2 or 8.3 with respect to Co-Development Products.

6. GOVERNANCE AND JOINT STEERING COMMITTEE

6.1 Project Leader. Within [* * *] after a Collaboration Target has been selected, Novo and Dicerna shall [* * *] to serve as the primary point of contact between the Parties with respect

to each Collaboration Target being Researched and Developed under the R&D Program (each, a "**Project Leader**"). The Project Leaders shall regularly communicate with each other to address R&D Program-related issues, needs and updates and facilitate communications and organization of Working Groups associated with each active Research Plan or Development Plan with respect to each Target. Either Party, upon prior notice to the other Party, may change its Project Leader. Additionally, the Parties may assign different Project Leaders for different Projects. Except for those Disputes that are subject to the purview of the JSC, prior to submitting any Dispute to the Program Leaders or dispute resolution mechanism set forth in Section 19.6, the Project Leaders shall attempt, for a period of [* * *], to resolve such Dispute.

6.2 Program Leader. Within [* * *] of the Effective Date, Novo and Dicerna shall [* * *] to serve as the primary point of contact between the Parties with respect to all Collaboration Targets being Researched and Developed under the R&D Program (each, a "**Program Leader**"). The Program Leader will be responsible for overseeing the list of Collaboration Targets, the Discontinued Targets and the Continuation Targets. The Program Leaders shall regularly communicate with each other to address R&D Program-related issues, needs and updates and facilitate communications and organization of Project Leaders, Working Groups associated with all active Research Plan or Development Plan with respect to all Targets. Either Party, upon prior notice to the other Party, may change its Program Leader. If the Project Leaders cannot agree under Section 6.1 on the Dispute, then, except for those Disputes that are subject to the purview of the JSC, prior to submitting any Dispute to the dispute resolution mechanism set forth in Section 19.6, the Program Leaders shall attempt, for a period of [* * *], to resolve such Dispute.

6.3 Alliance Leader. Within [* * *] of the Effective Date, each Party shall also appoint an individual to act as the Alliance Leader at director level or above for such Party (each, an "**Alliance Leader**"). Each Alliance Leader shall thereafter be permitted to attend meetings of the JSC and any sub-committee as a nonvoting observer. The Alliance Leaders shall be the primary point of contact for the Parties regarding the collaboration activities contemplated by this Agreement (other than the activities/responsibilities of the Project Leader outlined in Section 6.1 and the activities/responsibilities of the Program Leader outlined in Section 6.2) and shall help facilitate all such activities hereunder. For avoidance of doubt, the individual appointed by a Party to act as an Alliance Leader may, but need not, be the same individual appointed by such Party as the Program Leader or as a Project Leader.

6.4 Working Groups. The Parties may establish working groups (each, a "**Working Group**") to oversee the activities of the Research Plan or Development Plan. In addition, from time to time, the Parties may establish a Working Group to oversee particular additional projects or activities. Each Working Group shall undertake the activities delegated to it by the JSC. During the process of establishing each Working Group, such Working Group and the JSC shall agree regarding which matters such Working Group will resolve on its own and which matters such Working Group will advise the JSC (and with respect to which such advice-specific matters the JSC will resolve). In addition to the Target-specific Working Groups overseen by the respective Project Leaders, the Parties shall, at a minimum, establish [* * *] additional Working Groups to oversee, respectively, (i) technology transfer pursuant to Section 7.4, (ii) the manufacturing supply chain for the Products, (iii) disclosure of Program Inventions and strategy for prosecution and

maintenance of Joint Inventions (the "**Patent Working Group**"); and (iv) with respect to work conducted through Proof of Principle and, with respect to the first Development Candidate, through the first IND filing, matters relating to chemistry, manufacturing and controls (the "**CMC Working Group**").

6.5 Joint Steering Committee.

6.5.1 Establishment. As soon as practicable after the Effective Date, the Parties shall establish a Joint Steering Committee (the "**JSC**") to oversee and coordinate the activities of the Parties under the R&D Program. The Parties will either continue the JSC or establish additional committees to oversee and coordinate the activities of the Parties during the R&D Collaboration Term and the Development and Commercialization of Products. The JSC shall be comprised of [* * *] from Novo and [* * *] from Dicerna, which the JSC may increase as its discretion. Subject to the foregoing, each Party shall appoint its respective representatives to the JSC from time to time, and may change its representatives, in its sole discretion, effective upon notice to the other Party designating such change. Representatives from each Party shall have appropriate technical credentials, experience and knowledge pertaining to and ongoing familiarity with the R&D Program. [* * *] of the JSC appointed by [* * *] shall be designated the JSC Chair (the "**JSC Chair**"). The JSC Chair will be responsible for calling meetings of the JSC, circulating agendas and performing administrative tasks required to assure efficient operation of the JSC but shall not have any extra or additional vote.

6.5.2 JSC Meetings. The JSC shall meet in accordance with a schedule established by mutual written agreement of the Parties, and no less frequently than [* * *] until expiration of the R&D Collaboration Term or as mutually agreed. The JSC may meet by means of teleconference, videoconference or other similar means. As appropriate, additional employees or consultants may from time to time attend the JSC meetings as nonvoting observers, provided that any such consultant shall agree in writing to comply with the confidentiality obligations under this Agreement; and provided further that no Third Party personnel may attend unless otherwise agreed by both Parties. Each Party shall bear its own expenses related to the attendance of the JSC meetings by its representatives. Each Party may also call for special meetings to resolve particular matters requested by such Party. The JSC Chair or his/her designee shall keep minutes of each JSC meeting that records in writing all decisions made, action items assigned or completed and other appropriate matters. Novo shall send meeting minutes to all members of the JSC promptly after a meeting for review. Each member shall have [* * *] from receipt in which to comment on and to approve/provide comments to the minutes (such approval not to be unreasonably withheld, conditioned or delayed). If a member, within such time period, does not notify Novo that s/he does not approve of the minutes, the minutes shall be deemed to have been approved by such member.

6.5.3 JSC Functions. The JSC's responsibilities with respect to the R&D Program are as follows:

(a) Overseeing and coordinating the activities of the Parties under the R&D Program;

(b) Facilitating the exchange of Know-How and materials as required hereunder;

(a) Approving plans and budgets for Development and Commercialization of Co-Development Products (with all such plans and budgets to be initially proposed by Novo other than Co-Development Products designated by Novo pursuant to Section 2.3.2 or Section 3.3);

(b) Periodically reviewing the progress of the R&D Program;

(c) Coordinating the Parties' documentation of Research Plans and Development Plans, suggesting updates to and modifications of each Research Plan and Development Plan and establishing the Validated Target Criteria for each Collaboration Target. For clarification, any update or modification to the Research Plan prior to Proof of Principle with respect to the relevant Compound shall require the consent of each Party and is subject to reaching an agreement between the Parties with regards to any potential implications of such modification or update; and

(d) Amending the Work Flow Plan.

6.5.4 JSC Disputes; Authority. The JSC will endeavor to make decisions by consensus, with each of Novo and Dicerna having [* * *]. If consensus is not reached by the Parties' representatives pursuant to such vote, then the matter may be escalated by either Party to designated officers of both Novo and Dicerna with appropriate decision-making authority. In the event the designated officers are unable to resolve the issue within [* * *], then: [* * *]. Notwithstanding the foregoing, neither Party may exercise decision making authority to unilaterally amend this Agreement, or to cause the other Party to perform any activities or incur any material expenses that are not contemplated in this Agreement or the Work Flow Plan, Research Plan or Development Plan, provided that during the pendency of any escalation or dispute resolution in accordance with this Section 6.5.4: [* * *].

6.5.5 Rights and Powers. For clarity and notwithstanding the creation of the JSC, each Party shall retain the rights, powers and discretion granted to it hereunder, and the JSC shall not be delegated or vested with such rights, powers or discretion unless such delegation or vesting is expressly provided herein, or the Parties expressly so agree in writing. The JSC shall not have the power to amend, waive or modify any term of this Agreement, and no decision of the JSC shall be in contravention of any terms and conditions of this Agreement. It is understood and agreed that issues to be formally decided by the JSC are limited to those specific issues that are expressly provided in this Agreement to be decided by the JSC. The JSC shall cease to operate, on a Product-by-Product basis, once Dicerna's option with respect to such Product under Section 2.3.3 has lapsed without being exercised, and any obligations of either Party to provide any information to the JSC with respect to such Product shall be deemed to be an obligation to provide such information directly to the other Party instead of through the JSC.

7. LICENSES

7.1 License Grant to Novo. Subject to the terms and conditions of this Agreement, Dicerna hereby grants to Novo: (a) an exclusive (even as to Dicerna), royalty bearing, sub-licensable (through multiple tiers) (subject to Section 7.2), worldwide, license under the Licensed Technology to Develop, register, make (including formulate), have made, use, and Commercialize Compounds and Products in the Field; and (b) a non-exclusive, non-royalty bearing, fully paid-up, sub-licensable (through multiple tiers) (subject to Section 7.2), worldwide license under Licensed Technology to carry out Novo's obligations under the R&D Program, including Research and Development work required to select Targets and related Compounds and Products for purposes of this Agreement. To the extent Dicerna is no longer subject to the exclusivity obligations granted under the Lilly Agreement (whether through the clearance process discussed in Section 2.6, termination of the Lilly Agreement, or otherwise), then, on a Collaboration Target-by-Collaboration Target basis, such license granted by Dicerna to Novo in this Section 7.1 will also extend to the Excluded Field with respect to all applicable Compounds and Products and Dicerna shall promptly notify Novo to such effect.

7.2 Sublicenses. [* * *].

7.3 License Grants to Dicerna. Novo hereby grants to Dicerna during the Term a non-exclusive, non-royalty bearing, fully paid-up, non-sub-licensable (except to Affiliates and Permitted Subcontractors of Dicerna solely as needed to perform services for Dicerna under this Agreement), worldwide license under Novo Intellectual Property, solely to the extent necessary for Dicerna to perform its duties and obligations according to the R&D Program.

7.4 Know-How Transfer; Availability of Employees. Within [* * *] following Novo's assumption of responsibility for Development or Commercialization of a Product under Article 4 or Novo's election to retain rights under Section 15.2, Dicerna shall disclose and/or deliver to Novo, to the extent not previously provided, copies of all data and information in Dicerna's possession relating to the Licensed Know-How which is reasonably necessary for Novo's Development or Commercialization of such Product (including for regulatory purposes). In addition, upon Novo's reasonable request, Dicerna shall disclose and/or deliver to Novo, to the extent not previously provided, copies of all data and information in Dicerna's possession that would be reasonably useful to Novo in manufacturing or having manufactured the Products, as well as authorization letters sufficient for Novo to be able to place Product orders directly with Dicerna's contract manufacturers pursuant to the terms of the applicable agreement between Dicerna and such manufacturers. Upon Novo's reasonable request, Dicerna will: (a) provide reasonable technical assistance to Novo during such disclosure or delivery set forth in the preceding two sentences; and (b) make its employees and non-employee consultants reasonably available at their respective places of employment to consult with Novo on issues arising in the course of Novo's Research, Development, Manufacturing or Commercialization and in connection with any request related to a Product from any Regulatory Agency, including regulatory, scientific, technical and clinical testing issues. The technology transfer to be undertaken under this Section 7.4 shall be overseen by the JSC or a Working Group established for such purposes, and the JSC or such Working Group may put in place a technology transfer plan expressly identifying Know-How Controlled by Dicerna to be transferred and the timing for such transfer.

7.5 Covenants. Dicerna covenants that it will not: (a) take any action that (i) would impose or result in a lien, charge or encumbrance of the Licensed Technology that would prevent or limit Novo's exercise of its licensed rights to such Licensed Technology, or (ii) adversely affects the license rights granted to Novo under this Agreement; or (b) assign, transfer, convey or otherwise grant to any Person any rights to any Licensed Technology, Joint Know-How or Joint Patent Rights or any Compounds or Products, in any manner that conflicts with the exclusive licenses granted to Novo pursuant to Section 7.1.

7.6 Mutual Use of Confidential Information. Subject to and without limiting any license rights or exclusivity granted to Novo under this Agreement, each Party and its Affiliates will have the right to use any Confidential Information disclosed by the other Party in connection with the R&D Program and retained in the unaided memories of its employees after having access to such Confidential Information (without reference to tangible copies of such information), provided that this right to use does not constitute a license under any Patent Rights or copyrights. An individual's memory will be considered to be unaided if [* * *]. Notwithstanding anything to the contrary under this Section 7.6 and except as expressly authorized in this Agreement (including as to generally applicable information), the foregoing does not permit any disclosure by either Party of any of the other Party's Confidential Information regarding the Collaboration Targets, Compounds or Products or disclosure by either Party of any of the other Party's Confidential Information in any unpublished patent application owned (either solely or jointly) by the other Party.

7.7 No Implied Licenses. Except as expressly set forth in this Agreement, neither Novo, on the one hand, or Dicerna, on the other hand, by virtue of this Agreement, shall acquire any license or other interest, by implication or otherwise, in any materials, Know-How, Patent Rights or other intellectual property rights Controlled by the other Party or its Affiliates not expressly granted under this Agreement. Furthermore, notwithstanding anything to the contrary in this Agreement, by entering into this Agreement with Dicerna, Novo is not forfeiting any rights that Novo may have, including its rights to perform research activities in compliance with 35 U.S.C. § 271(e)(1) or any experimental or research use exemption that may apply in any country.

7.8 Third Party IP Agreements.

7.8.1 Notwithstanding anything to the contrary in this Agreement, if after the Signing Date, Dicerna enters into any agreement with a Third Party under which Dicerna acquires Control of any Patent Rights or Know-How that would be necessary or reasonably useful for the Development or Commercialization of Collaboration Targets, Compounds, or Products, then Dicerna shall so notify Novo and Novo shall have the option to include such Patent Rights and Know-How in the rights and licenses granted to Novo under this Agreement. If Novo elects to include such rights and licenses, Novo shall (a) to the extent the Third Party agreement is a license agreement, be bound by the terms of such Third Party agreement applicable to a sublicensee thereunder, and (b) reimburse Dicerna for the portion of any amounts that become owing to such Third Party by reason of the grant to, or exercise by or under the authority of, Novo of such rights; provided, that, any amounts owing to such Third Party shall not be disproportionately allocated to the Collaboration Targets, Compounds, Products or Novo's rights hereunder (*e.g.*, the upfront payments, milestone payments, royalty for Product sales and other payments shall be fairly allocated

based on the extent to which such amounts are attributable to the applicable Collaboration Target, Compound or Product and taking into account exploitation of the Patent Rights and Know-How by Dicerna for other purposes). In such event, the amounts reimbursed by Novo shall be deductible as contemplated under Section 8.6.3(b) from all amounts owed to Dicerna under Sections 8.3 through 8.6. Upon request by Novo, Dicerna shall disclose to Novo a true and correct written description of the payment and other relevant obligations. In the event Novo does not agree in writing to reimburse Dicerna for such amounts upon request, and (if applicable) to be bound by the terms of such Third Party agreement applicable to a sublicensee thereunder, then the rights licensed under such Third Party agreement shall thereafter be deemed excluded from the Licensed Patent Rights and/or Licensed Know-How, as applicable, hereunder. Dicerna is solely responsible for, and shall make, all payments due to any Third Party licensors and assignors of rights included in the Licensed Technology pursuant to its agreements relevant to such rights, and Dicerna shall otherwise take all actions necessary to ensure that all such agreements remain in full force and effect.

7.8.2 If, after the Effective Date, Dicerna identifies Patent Rights or Know-How Covering or relating to RNAi or oligonucleotide platform technologies Controlled by a Third Party that would be necessary or reasonably useful for inhibition, disruption or modulation of mRNA in Collaboration Targets, then Dicerna shall so notify Novo and the Parties shall coordinate in good faith the negotiation of [* * *] agreements in order to facilitate Novo having access to such technology, which may be through an agreement directly between Novo and such Third Party. Any payments made by Novo to obtain such access shall be deductible as contemplated under Section 8.6.3(b).

8. FINANCIAL PROVISIONS

8.1 Upfront Payment; Escrow.

8.1.1 In consideration for the rights granted to Novo pursuant to this Agreement and Dicerna's performance of its obligations hereunder, including but not limited to, license grants under the Licensed Technology and Research and Development services, Dicerna shall invoice Novo and Novo shall deposit with the Escrow Agent in a non-interest bearing account a one-time upfront payment of One Hundred Seventy-Five Million U.S. Dollars (USD $175,000,000) (the "**Upfront Payment**"). Novo shall make such deposit to the Escrow Agent within [* * *] following the Effective Date, the payment of which to Dicerna shall be governed by this Section 8.1. Dicerna has provided an estimate for Research and Development services of [* * *] per Collaboration Target to achieve Proof of Principle and the Parties estimate that approximately [* * *] Collaboration Targets will be the subject to this Agreement. Within [* * *] after the Effective Date, Novo shall identify in writing [* * *] (the "**Initial Targets**"). Dicerna shall prepare and deliver to Novo a bioinformatics package and mapping plan for at least one of the Initial Targets which if not identified by Novo in such [* * *] period shall be one of the [* * *] Hepatocyte Targets previously cleared by Dicerna by the Gatekeeper (the "**Bioinformatics Package and Mapping Plan**"). Upon delivery to Novo of the Bioinformatics Package and Mapping Plan, Dicerna shall certify to the Escrow Agent such delivery, whereupon the Escrow Agent shall pay to Dicerna the Upfront Payment, which shall be non-refundable and non-creditable, within [* * *] of such certification. Novo shall execute, acknowledge and deliver any and all documents and take any action as may be reasonably necessary

to assist Dicerna under the foregoing or to otherwise carry out the intent and purposes of this Section 8.1.

8.1.2 In the event the Bioinformatics Package and Mapping Plan is not delivered within [* * *] after the Effective Date, as will be extended for factors outside Dicerna's reasonable control, the Escrow Agent shall return the Upfront Payment. All costs and expenses associated with the Escrow Agent and Escrow Agreement shall be borne by Dicerna. In the event that the Escrow Agent fails to return the Upfront Payment to Novo as required by this Section 8.1.4, Dicerna shall immediately repay such amount to Novo upon Novo's demand, and in the event that the Escrow Agent fails to release the Upfront Payment to Dicerna as required by Section 8.1.3, Dicerna shall hold harmless Novo from such failure and the payment of the Upfront Payment to Dicerna shall be deemed to have been made in full by Novo.

8.2 Annual Fee. As additional consideration for the rights granted to Novo pursuant to this Agreement, including license grants under the Licensed Technology, and for Dicerna's performance of certain obligations hereunder, Novo shall pay to Dicerna Seventy-Five Million U.S. Dollars (USD $75,000,000) to be split into three non-refundable, non-creditable annual payments of Twenty-Five Million U.S. Dollars (USD $25,000,000), provided that Dicerna meets the requirements to deliver the minimum number of Mapped Targets as set forth below. Dicerna shall invoice Novo and Novo shall pay the annual payments within [* * *] of (1) the first anniversary of the Effective Date, if Dicerna has delivered to Novo at least [* * *] Mapped Targets or, if fewer Collaboration Targets are selected by Novo to be Mapped Targets, such fewer number of Mapped Targets, (2) the second anniversary of the Effective Date, if Dicerna has delivered another at least [* * *] (or such fewer additional Collaboration Targets selected by Novo to be Mapped Targets) Mapped Targets in addition to the initial minimum number of Mapped Targets delivered under clause (1) of this Section 8.2 and (3) the third anniversary of the Effective Date, if Dicerna has delivered another at least [* * *] (or such fewer additional Collaboration Targets selected by Novo to be Mapped Targets) Mapped Targets in addition to the initial minimum number of Mapped Targets delivered under clauses (1) and (2) of this Section 8.2. In the event Novo terminates pursuant to Section 14.2 or Dicerna terminates pursuant to Section 14.3, prior to the third anniversary of the Effective Date, then [* * *] of the outstanding, unearned annual payments will become due and payable by Novo to Dicerna.

8.3 Pre-Clinical Milestones; DC Milestones.

8.3.1 Pre-Clinical Milestones. Except for Co-Development Products, which shall not be eligible for milestone payments under this Section 8.3, on a Collaboration Target-by-Collaboration Target (other than Dicerna Orphan Liver Targets) basis, with respect to a Product Directed To the applicable Collaboration Target, within [* * *] after first achievement of either (1) Proof of Principle for the first Product Directed To the first applicable Collaboration Target or (2) Initiation of GLP Tox Studies for the first Product Directed To all subsequent applicable Collaboration Targets (each, a "**Pre-Clinical Milestone Event**"), Novo shall notify Dicerna and make a [* * *] milestone payment to Dicerna (each, a "**Pre-Clinical Milestone Payment**"). Such payment shall be non-refundable and non-creditable and due only once for the first Product Directed To the applicable Collaboration Target to achieve the Pre-Clinical Milestone Event regardless of

the repeated achievement of the Pre-Clinical Milestone Event by the same Product, irrespective of how many indications for which the Product is Developed or Commercialized. For the avoidance of doubt, if any Pre-Clinical Milestone Payment is made with respect to a particular Product, such Pre-Clinical Milestone Payment will not be due for any other Product hereunder that is Directed To the same Target as such Product.

8.3.2 **DC Milestones**. If at least [* * *] Compounds achieve Proof of Principle and are nominated as Development Candidates as contemplated under Section 2.2, then for each subsequent Compounds that achieves Proof of Principle and is nominated as a Development Candidate (i.e., for the [* * *] and subsequent such Compounds), Novo shall make a first [* * *]) milestone payment to Dicerna upon such achievement and nomination and a second [* * *] milestone payment to Dicerna upon the first dosing of a patient in a Phase 1 Clinical Trial with such Compound. Such payments shall be non-refundable and non-creditable.

8.4 **Development and Regulatory Milestones**. Except for Co-Development Products, which shall not be eligible for milestone payments under this Section 8.4, on a Collaboration Target-by-Collaboration Target (other than Dicerna Orphan Liver Targets) basis, within [* * *] after first achievement of each milestone set forth in the table below by Novo, its Affiliate or sublicensee of Novo's rights with respect to the first Product Directed To the applicable Collaboration Target (each, a "**Development and Regulatory Milestone Event**"), Novo shall notify Dicerna and make the corresponding milestone payment to Dicerna (each, a "**Development and Regulatory Milestone Payment**"). Such payment shall be non-refundable and non-creditable and [* * *].

Development and Regulatory Milestone Events		**Development and Regulatory Milestone Payments**
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]

8.5 Commercialization Milestones. Subject to Sections 2.3.2 and 5.4, except for Co-Development Products, which shall not be eligible for milestone payments under this Section 8.5 if such Products are designated as Co-Development Products, on a Collaboration Target-by-Collaboration Target basis, within [* * *] after the end of the [* * *] in which each milestone event set forth in the table below is first achieved by Novo, its Affiliate or its sublicensee (unless Dicerna or its Affiliate is the sublicensee) of Novo's rights with respect to the first Product Directed To the applicable Collaboration Target (each, a "**Commercial Milestone Event**"), Novo shall notify Dicerna and make the corresponding, non-refundable (except as set forth in Section 5.4), non-creditable milestone payment to Dicerna (each, a "**Commercial Milestone Payment**"):

	Commercial Milestone Events	Commercial Milestone Payments
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
[* * *]	[* * *]	[* * *]
	[* * *]	[* * *]

The Commercial Milestone Payment shall be payable only once, irrespective of how many indications for which the first Product is Developed or Commercialized. For the avoidance of doubt, if any Commercial Milestone Payment is made with respect to a particular Product, such Commercial Milestone Payment shall be payable for any other Product hereunder that is Directed To the same Target as such Product.

8.6 Royalties.

8.6.1 Royalty Payments. Subject to Sections 2.3.2, 2.3.3, 3.3 and 5.4, except for Co-Development Products, which shall not be eligible for royalties under this Section 8.6 if such Products are designated as Co-Development Products, on a Product-by-Product basis, within [* * *] after the end of each Calendar Year during the Royalty Term, Novo shall pay Dicerna a royalty on only that portion of Net Sales of a Product as designated below and at the rates set forth below (each such royalty payment, a "**Royalty**"):

Annual Worldwide Net Sales on a Product-by-Product basis	Royalty Rate
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]
[* * *]	[* * *]

8.6.2 Royalty Term. The Royalty will be payable on a country-by-country and Product-by-Product basis from First Commercial Sale of the Product in such country and shall terminate upon the latest of: (a) such Product no longer being Covered by at least one Effective

Patent Claim in such country that is either (1) Controlled by Dicerna or one of its Affiliates as of the Signing Date or (2) Controlled by Dicerna or one of its Affiliates only after the Signing Date and claiming an Invention conceived by Dicerna or one of its Affiliates that is a GalXC Patent or a Product-Specific Patent; (b) the expiration of New Chemical Entity Regulatory Exclusivity granted to such Product, but no longer than [* * *] from such grant; and (c) [* * *] after the First Commercial Sale of such Product in such country (the "**Royalty Term**"), in each case subject to Section 8.6.3. For the avoidance of doubt, any Patent Rights Covering Improvements to GalXC Platform IP that are discovered, conceived or otherwise generated solely by Novo and assigned to Dicerna under Section 10.4 are not within the scope of the Effective Patent Claims described in the foregoing Section 8.6.2(a), and no Royalties will be payable by Novo with respect to any such Patent Rights.

8.6.3 Royalty Step-Downs. The Royalties under Section 8.6.1 shall be reduced by the following step-down provisions:

(a) **Effective Patent Claims**.

(i) Notwithstanding Section 8.6.1, on a country-by-country and Product-by-Product basis, if at the time of or after the First Commercial Sale of a particular Product in a country or anytime thereafter, such Product is not Covered by one or more Effective Patent Claims in such country, then the Royalty at which Novo is required to pay during the Royalty Term to Dicerna on the Net Sales of such Product in such country shall be reduced by [* * *] of the Royalty rate set forth in Section 8.6.1 for the rest of the Royalty Term.

(ii) Notwithstanding Section 8.6.1, on a country-by-country and Product-by-Product basis, if at the time of or after the First Commercial Sale of a particular Product in a country or anytime thereafter, either (A) such Product is not Covered by one or more Effective Patent Claims of Product-Specific Patents but is Covered by one or more Effective Patent Claims in other Licensed Patent Rights in such country or (B) such Product is not Covered by any issued Effective Patent Claim but is Covered by a pending Effective Patent Claim, then the Royalty at which Novo is required to pay during the Royalty Term to Dicerna on the Net Sales of such Product in such country shall be reduced by [* * *] to [* * *] of the Royalty rate set forth in Section 8.6.1 for the rest of the Royalty Term.

(b) **Third Party Payments – Anti-Stacking**. If Novo reasonably determines that Novo and/or its Affiliates or sublicensees need to acquire a Third Party's Patent Rights (excluding Patent Rights solely claiming methods of Manufacture) or obtain a license under a Third Party's Patent Rights in order to avoid infringement of such Patent Rights (including a patent of an Acquirer that is not part of the Licensed Patents) in order to Research, Develop or Commercialize a Compound or Product in a particular country or in the event that Novo makes any payments to Dicerna or a Third Party as contemplated under Sections 7.8, then Novo shall have the right to deduct [* * *] of all payments due from Novo and/or its

Affiliates or sublicensees under the applicable agreement with the Third Party and all such payments as contemplated under Section 7.8 from the payments owed to Dicerna under Sections 8.3 through 8.5 and the Royalty owing to Dicerna during the applicable period for the such Product under Section 8.6.1, as applicable, subject to the Royalty reduction floor as set forth in Section 8.6.3(d).

(c) **Generic Competition**. On a country-by-country and Product-by-Product basis, if Generic Products reach a market share, on a unit basis, equal to or higher than [* * *] of the aggregate units of such Generic Products and a Product containing a GalXC Molecule Directed To the same Collaboration Target as such Generic Products sold in any country during any [* * *], then Novo's obligation to pay Royalties to Dicerna for the applicable Product in the applicable country under Section 8.6.1 shall be reduced by [* * *] beginning with such [* * *]. On a country-by-country and Product-by-Product basis, if Generic Products reach a market share, on a unit basis, equal to or higher than [* * *] of the aggregate units of such Generic GalXC Products and a Product containing a GalXC Molecule Directed To the same Collaboration Target as such Generic GalXC Products sold in any country during any [* * *], then Novo's obligation to pay Royalties to Dicerna for the applicable Product in the applicable country shall terminate and be of no further force or effect for and after such [* * *], at which point the Royalty Term for that Product shall also be considered terminated in that country. For purposes of the foregoing royalty reductions, unit sales shall be determined by reference to applicable sales data obtained from IQVIA or from such other source for such sales data as may be agreed by the Parties; provided that if applicable sales data is not available from IQVIA and the Parties are unable to agree on an alternative data source, Novo may determine a reasonable alternative data source after consultation with the JSC, which reasonable alternative shall be a well-established data source widely used in the pharmaceutical industry.

(a) **Limit on Royalty Reductions**. In no event shall the Royalties owed under Section 8.6.1, with respect to a Product in a country, be reduced by operation of Sections 8.6.3(a) or 8.6.3(b) by more than an aggregate of [* * *] of what would otherwise be owed under the table set forth in Section 8.6.1 with respect to such Product in such country. To the extent that the reductions under Sections 8.6.3(a) or 8.6.3(b) would, but for the limitation in the foregoing sentence, result in a Royalty that would be less than [* * *] of what would otherwise be owed, the difference between such lower Royalty and the Royalty payable due to the forgoing limitation shall be carried forward and deducted against any and all subsequent payments due to Dicerna from Novo hereunder until the end of the Royalty Term. For the avoidance of doubt, the foregoing limitation on reductions does not affect Section 8.6.3(c), and any reduction under Section 8.6.3(c) shall be made net of any reductions made pursuant to Sections 8.6.3(a) and 8.6.3(b) (e.g., if the maximum reduction of [* * *] is reached under Sections 8.6.3(a) and 8.6.3(b) and the reduction of [* * *] in Section 8.6.3(c) is also reached, the net Royalty will be [* * *] of what would otherwise be owed).

8.1 Co-Development Programs. With respect to Co-Development Products, the Parties shall share in costs, profits and losses as described under Section 5.4 and Exhibit F.

9. REPORTS AND PAYMENT TERMS

9.1 Net Sales Reports and Royalties Due. During the Royalty Term, Novo shall furnish to Dicerna a written report for each [* * *] showing the global Net Sales by Product, except for Co-Development Products, sold by Novo, its Affiliate or sublicensee during the reporting [* * *], the Royalties payable under this Agreement and whether a Commercial Milestone Event has been achieved in sufficient detail to allow Dicerna to verify the amount of Royalties or Commercial Milestone Payments paid by Novo with respect to such Calendar Quarter, including on a Product-by-Product basis, the Net Sales of each Product, and the Royalties (in USD) payable and in total for all Products. Reports shall be due no later than [* * *] following the end of each Calendar Quarter. Royalties shown to have accrued by each report provided under this Section 9.1 and any Commercial Milestone Payment achieved in such Calendar Quarter shall be due and payable on the date such report is due.

9.1 Payment Currency / Exchange Rate. All payments to be made by Novo to Dicerna under this Agreement shall be made in USD. Payments to Dicerna shall be made by electronic wire transfer of immediately available funds to the account of Dicerna, as designated in writing to Novo. If any currency conversion is required in connection with the calculation of amounts payable hereunder, such conversion shall be made in accordance with Section V of Exhibit F.

9.1 Novo Nordisk Invoicing Instructions. Any payment payable by Novo under this Agreement, including payments under Sections 4.4.2, 5.4.2, 5.4.3, 8.1, 8.2, 8.3, 8.4, 8.5 and 8.6, is subject to receipt by Novo of an invoice prepared in accordance with the Novo Nordisk Invoicing Instructions set forth in Exhibit C.

9.1 Taxes.

Each Party shall be responsible for the payment of all income and other taxes (including interest) ("**Taxes**") imposed on its own income arising under this Agreement.

9.1.1 If Applicable Laws require the withholding of Taxes by either Party or its Affiliates, such Taxes shall be retained by the Party making such payment (the "**Payor**") as required by such Applicable Law from such remittable royalty or other payment and shall be timely remitted by the Payor to the proper tax authorities on behalf of the Party with respect to which such deduction and withholding was made (the "**Payee**"); provided, however, that notwithstanding anything in this Agreement to the contrary, if Novo's assignment of this Agreement leads to the imposition of any additional withholding Tax liability on Dicerna that would not have been imposed in the absence of such action or in an increase in such liability above the liability that would have been imposed in the absence of such action, Novo will indemnify and hold harmless Dicerna from any such additional or increased withholding Tax liability (except to the extent that Dicerna or any of its Affiliates can reclaim it, provided that Dicerna will be reimbursed for any reasonable out of pocket costs incurred in the reclaim). If Dicerna's assignment of this Agreement leads to a requirement for Novo to withhold any additional Tax, the imposition of any additional withholding Tax liability that would not have been imposed in the absence of such action or in an increase in such liability above the liability that would have been imposed in the absence of such action, Dicerna will be

liable for such additional or increased withholding Tax and indemnify and hold Novo harmless from any such additional or increased withholding tax liability (except to the extent that Novo or any of its Affiliates can reclaim it, provided that Novo will be reimbursed for any reasonable out of pocket costs incurred in the reclaim). The Parties shall cooperate and exercise their reasonable best efforts to ensure that any such withholding Taxes are mitigated or reduced to the extent possible under the provisions of any Applicable Law, and shall provide Payee reasonable assistance (including the provision of any Tax forms and other information) in order to allow Payee to obtain the benefit of any present or future treaty against double taxation or exemption from refund or reduction in Taxes which may apply to such payments. To the extent that a Party is required to deduct and withhold Taxes on any such payment pursuant to this Section 9.4, such Party will provide the Payee with written notice of the required withholding as promptly as reasonably practical (and in any event, no later than [* * *]) prior to making such payment. To the extent such amounts are so deducted and withheld and timely remitted to the relevant tax authorities, such amounts shall be treated for all purposes under this Agreement as having been paid to the Person to whom such amounts would otherwise have been paid. The Payor shall promptly (as available) submit to the Payee appropriate proof of payment of the withheld Taxes as well as the official receipts sufficient to enable the Payee to claim credits for such payments of Taxes.

9.1.2 Novo shall use reasonable efforts to obtain and deliver to Dicerna on an annual basis and within [* * *] of Dicerna's request to provide, information as reasonably requested by Dicerna that is sufficient to meet any documentation requirements imposed by regulations issued under Section 250 of the Internal Revenue Code of 1986, as amended (the "**Internal Revenue Code**"), for the treatment of an appropriate portion of such amounts as "foreign-derived deduction eligible income" within the meaning of Section 250 of the Internal Revenue Code and the regulations thereunder. Novo shall not be required to deliver such information which Novo reasonably deems sensitive or which would be unlawful according to Danish or U.S. law. Dicerna shall compensate Novo for any internal and external costs associated with obtaining and delivering the information to Dicerna.

9.1.3 The Parties intend that this Agreement will not be treated as a partnership or joint venture for United States federal and state tax purposes, and each Party will file all tax returns and will otherwise take all tax reporting positions in a manner consistent with such treatment.

9.1.4 It is understood and agreed between the Parties that any payments made by any Party under this Agreement are exclusive of any value added tax ("**VAT**") or similar Tax imposed upon such payments. Where VAT is properly added to a payment made under this Agreement, the paying Party will pay the amount of VAT only on receipt of a valid Tax invoice issued in accordance with Applicable Law.

9.2 Audit Rights (Financial).

9.2.1 [* * *].

9.2.2 [* * *].

1. INTELLECTUAL PROPERTY RIGHTS

1.1 Disclosure of Inventions. [* * *].

1.2 Notification of Issuance. Novo and Dicerna shall each promptly notify the other in writing of any issuance of each patent included in the Licensed Patent Rights or Joint Patent Rights of which they become aware *via* the Patent Working Group.

1.3 Novo Background IP. [* * *].

1.4 Dicerna Background IP. As between the Parties, Dicerna shall own and Control all right, title and interest in and to all Patent Rights or Know-How Controlled by Dicerna and existing as of or before the Effective Date, including any GalXC Platform IP, or generated or acquired outside the scope of the R&D Program and this Agreement, and shall own any Improvements to any of the foregoing made by Dicerna or an Affiliate of Dicerna and any Improvements to GalXC Platform IP made by Novo or an Affiliate of Novo generated in connection with this Agreement, but excluding Novo Product Patents, Product-Specific Patents and Product-Specific Know-How ("**Dicerna Background IP**"). Novo hereby assigns and agrees to assign to Dicerna all right, title and interest in and to any Improvements to GalXC Platform IP, that are discovered, conceived or otherwise generated by Novo in connection with the R&D Program or otherwise under the Agreement. For purposes of clarity, (1) Improvements to GalXC Platform IP do not constitute Joint Patent Rights and (2) Joint Patent Rights do not constitute Improvements to GalXC Platform IP. If the Parties determine by mutual agreement that any Novo Know-How shall necessarily be contributed to the development of the GalXC Platform, the Parties shall develop a mutually acceptable strategy for prosecution of any Patent Rights directed to such Novo Know-How through a joint patent process *via* the Patent Working Group, prior to contributing such Novo Know-How to the GalXC Platform.

1.5 Program Inventions; Joint Inventions.

1.5.1 Ownership. [* * *].

1.5.2 Exploitation[* * *].

1.5.3 Assignment and Transfer of Interests in Joint Inventions. [* * *].

1.6 Cooperation. Each Party represents and covenants that all of such Party's employee(s), contractor(s) and agent(s) are or will be obligated under a binding written agreement or otherwise to assign to such Party all Program Inventions made or conceived by such employee(s), contractor(s) or other agent(s) in connection with this Agreement. The Parties shall cooperate to file, prosecute, and maintain Joint Inventions and Joint Patent Rights as may reasonably be needed.

1.7 Filing, Prosecution, Enforcement and Defense.

1.7.1 GalXC Patents and Dicerna Background IP. [* * *].

1.7.2 Product-Specific Patents. [* * *].

1.7.1 Joint Patent Rights. [* * *].

1.7.2 Abandonment of Patent Rights. If either Party elects to cease the filing, prosecution, maintenance and/or defense of a Patent Right for which Dicerna or Novo, as applicable, is in control of the filing, prosecution, maintenance and/or defense of Product-Specific Patents pursuant to Section 10.7.2 or Joint Patent Rights pursuant to Section 10.7.3 in any country of the Territory, the abandoning Party shall provide the other Party with written notice promptly following its decision to abandon the filing, prosecution, maintenance and/or defense of such Patent Right, but in no event later than [* * *] before the next relevant deadline relating to or any public disclosure of the relevant Patent Right. In such event, the abandoning Party shall permit the other Party, at such other Party's sole discretion, to take over or continue, as the case may be, the filing, prosecution, maintenance and defense of such abandoned Patent Right on behalf of and in the name of the abandoning Party, but at the other Party's own expense. If the other Party elects to take over and continue such filing, prosecution, maintenance or defense, the abandoning Party shall execute such documents and perform such acts, at the other Party's expense, as may be reasonably necessary to permit the other Party to take over and continue the filing, prosecution, maintenance and/or defense of such abandoned Patent Right on behalf and in the name of the abandoning Party and at the other Party's own expense. For the avoidance of doubt, the abandoning Party shall remain the owner of the abandoned Patent Right(s) but shall have no further say in the filing, prosecution, maintenance and defense of such abandoned Patent Right(s); provided, however, that the other Party shall timely inform the abandoning Party if it too decides to finally abandon the respective Patent Right, in which event the abandoning Party shall have the right to re-assume sole responsibility for ongoing prosecution, maintenance and defense of such abandoned Patent Right in accordance with this Section 10.7.4. Notwithstanding the foregoing, if Novo determines, in its sole discretion following good faith discussions with Dicerna, that any such abandonment is necessary to avoid detrimental effect to any Product-Specific Patent or Joint Patent Right, then, subject to Sections 10.7.2 and 10.7.3, Dicerna shall have no right pursuant to this Section 10.7.4 to elect to take over and continue the filing, prosecution, maintenance or defense of such Product-Specific Patent or Joint Patent Right.

1.7.3 Notification of Infringement. Novo and Dicerna shall each promptly notify the other in writing of any alleged or threatened infringement of the Licensed Patent Rights or Joint Patent Rights of which they become aware (each, an "**Action**"), and the prosecution and enforcement of such alleged or threatened infringement of the Licensed Patent Rights or Joint Patent Rights shall be done in accordance with this Section 10.7.

1.7.4 Control of Enforcement Actions. The Party specified in this Section 10.7 as having control over enforcement of particular Patent Rights alleged or threatened to be infringed in an Action (the "**Initial Party**") may commence litigation with respect to the alleged or threatened infringement at its own expense or otherwise seek to handle such Action. If the Initial Party elects, in its sole discretion, to handle such an Action, the Initial Party shall control such Action, and the Initial Party may enter into settlements, stipulated judgments or other arrangements respecting such infringement; provided, however, the Initial Party shall not take any action, including legal action, settle or make any agreement that adversely affects the other Party's rights or interests, including any settlement or agreement which admits or concedes that any aspect of any of the Joint Patent Rights or Licensed Technology is invalid or unenforceable or which adversely affects the scope of any of the Joint Patent Rights or Licensed Technology (in cases where Dicerna is the Initial Party) or Licensed Technology (in cases where Novo is the Initial Party), without the prior written consent

of the other Party. The Initial Party shall keep the other Party reasonably apprised of the progress of any such Action. The other Party may, at its option and sole expense, be represented by counsel of its choice, but all other expenses associated with any such Action shall be at the sole expense of the Initial Party. In the event that the Initial Party does not commence litigation or otherwise address an Action within [* * *] following the date on which Novo or Dicerna (as applicable) notifies the other Party of any alleged or threatened infringement of the Licensed Patent Rights or Joint Patent Rights of which they become aware pursuant to Section 10.7.5, the other Party may do so, at the other Party's expense; provided, however, that: [* * *]. Notwithstanding the foregoing, if an Action involves Product-Specific Patents, Novo may determine whether or not to enforce such Product-Specific Patents in its sole discretion; provided that Novo shall not enforce such Product-Specific Patents except against infringing Competing GalXC Products. In any Action, (a) the Party not in control of enforcing such Action will reasonably cooperate with the enforcing Party, including, if required to bring such action, the furnishing of a power of attorney, and (b) any damages or other recovery, including compensatory and other non-compensatory damages or recovery actually received from a Third Party, shall first be used to reimburse the Parties for their respective reasonable costs and expenses incurred in connection with such Action. Any remaining recovery shall be paid to Novo and [* * *].

1.7.5 Patent Term Extension. The Parties shall consult with and cooperate and coordinate with each other in obtaining patent term extensions or supplemental protection certificates and the like with respect to the Licensed Patent Rights, in each country and region where it is possible to do so. Novo will elect whether to pursue patent term extensions or supplemental protection certificates [* * *] and Dicerna agrees to abide by such election. Any request by Novo to pursue patent term extensions or supplemental protection certificates [* * *] shall not unreasonably be refused by Dicerna. Dicerna shall provide prompt and reasonable assistance, as requested by Novo, at Novo's reasonable, pre-approved expense, including by taking such action as may be required of the patent holder under any Applicable Laws to obtain such patent extension or supplementary protection certificate.

1.7.1 Patent Listing. Novo will promptly, accurately and completely list, with the applicable Regulatory Authorities during the Term, all applicable [* * *] for a Product. Prior to such listings, the Parties will meet, through the JSC, to evaluate and identify all applicable Patent Rights. Notwithstanding the preceding sentence, Novo will retain final decision-making authority as to the listing of all applicable [* * *].

1.7.2 Filing Countries. [* * *].

1.8 Management of Novo Background Patents. Novo shall have sole responsibility for and control over the filing, prosecution, maintenance and enforcement of the Novo Patents (other than the Joint Patent Rights), at Novo's sole expense.

1.9 Product Infringement. [* * *].

1.10 Product Trademarks. Novo will be free, in its sole discretion, to use and to register in any trademark office in the Territory any trademark for use with a Product; provided, that nothing herein shall grant Novo any right to use any trademark Controlled by Dicerna and/or its Affiliates.

Subject to the foregoing, Novo shall have the right to select, and shall own all right, title and interest in and to, any such trademark relating to a Product that it selects during and after the Term. Upon Dicerna's request, Novo shall recognize Dicerna in a press release associated with the Regulatory Approval of any Product.

1.1 Inventorship and Title. Inventorship of inventions shall be determined in accordance with the patent laws of the United States.

1.2 Invention Disclosure and Recordkeeping. Each Party shall use its established policies to ensure that all inventions shall be documented by employees and consultants conducting research subject to this Agreement, in a way that makes clear: (a) the identity of each individual involved in any particular experimental result and the identity of each individual creating any document concerning the research; (b) the date that each particular experiment was executed; and, (c) the date each experimental result was recorded.

1.3 Consultation on Program Inventions. Neither Party will knowingly and intentionally take an action that could reasonably be expected to give rise to a declaratory judgment action seeking nullity of a Program Invention without consulting the other Party. However, if any Program Invention, other than a Product-Specific Patent, becomes the subject of a legal action or claim seeking declaratory relief, revocation or nullity of Program Invention, or is subject to an interference, *inter partes* re-examination, opposition or similar proceeding with regard to a Program Invention, the Parties shall promptly consult with one another concerning the defense of such action, claim or proceeding.

2. CONFIDENTIALITY

2.1 Duty of Confidence. During the Term and for [* * *] thereafter, all Confidential Information disclosed by one Party to the other Party hereunder shall be maintained in confidence by the receiving Party and shall not be disclosed to any Third Party or used for any purpose, except as set forth herein, without the prior written consent of the disclosing Party. The recipient Party may only use Confidential Information of the other Party for purposes of exercising its rights and fulfilling its obligations under this Agreement and may disclose Confidential Information of the other Party and its Affiliates to employees, agents, contractors, consultants and advisers of the recipient Party and its Affiliates, licensees and actual and potential sublicensees to the extent reasonably necessary for such purposes; provided that such persons and entities are bound by confidentiality and non-use of the Confidential Information substantially as protective as the confidentiality provisions of this Agreement as they apply to the recipient Party.

2.2 Exceptions. The obligations under this Article 11 shall not apply to any information to the extent the recipient Party can demonstrate by competent written evidence that such information:

(a) is (at the time of disclosure) or becomes (after the time of disclosure) known to the public or part of the public domain through no breach of this Agreement by the recipient Party or its Affiliates;

(b) was known to, or was otherwise in the possession of, the recipient Party or its Affiliates prior to the time of disclosure by the disclosing Party;

(c) is disclosed to the recipient Party or an Affiliate by a Third Party on a non-confidential basis that is entitled to disclose it without breaching any confidentiality obligation with respect to such information; or

(d) is independently developed by or on behalf of the recipient Party or its Affiliates, as evidenced by its written records, without use of or reference to the Confidential Information disclosed by the disclosing Party or its Affiliates under this Agreement.

2.3 Authorized Disclosures. Subject to this Section 11.3, the recipient Party may disclose Confidential Information (including the Agreement) belonging to the other Party as follows:

2.3.1 if such disclosure is deemed necessary by counsel to the recipient Party to be disclosed to such Party's attorneys, independent accountants or financial advisors for the sole purpose of enabling such attorneys, independent accountants or financial advisors to provide advice to the receiving Party, on the condition that such attorneys, independent accountants and financial advisors are bound by confidentiality and non-use obligations substantially as protective as the confidentiality provisions of this Agreement as they apply to the recipient Party.

2.3.2 to governmental or other regulatory agencies in order to obtain and maintain Patent Rights consistent with Article 10, but provided that such disclosure may be only to the extent reasonably necessary to obtain and maintain Patent Rights.

2.3.3 to governmental or other regulatory agencies by (a) Novo or a Novo Affiliate, licensee or sublicensee to gain or maintain approval to conduct Clinical Trials for a Product, to obtain and maintain Marketing Authorization or to otherwise Research, Develop and Commercialize Products, or (b) Dicerna or a Dicerna Affiliate, licensee or sublicensee to gain or maintain approval to conduct Clinical Trials for a Returned Compound or Product, to obtain and maintain Marketing Authorization or to otherwise Research Develop and Commercialize Returned Compounds and Products, but provided, in each case, that such disclosure may be only to the extent reasonably necessary to obtain or maintain Marketing Authorizations.

2.3.4 to the extent required in connection with any judicial or administrative process relating to or arising from this Agreement (including any enforcement hereof) or to comply with applicable court orders or governmental regulations.

2.3.5 if the recipient Party is required by judicial or administrative process to disclose Confidential Information that is subject to the non-disclosure provisions of this Article 11, in which case such Party shall promptly inform the other Party of the disclosure that is being sought in order to provide the other Party an opportunity to challenge or limit the disclosure obligations. Confidential Information that is disclosed as permitted by this Section 11.3 shall, provided that such disclosure to the extent possible does not cause such Confidential Information to become known to the public or become part of the public domain, remain otherwise subject to the confidentiality

and non-use provisions of this Article 11, and the Party disclosing Confidential Information as permitted by this Section 11.3 shall take all steps reasonably necessary, including obtaining an order of confidentiality and otherwise cooperating with the other Party, to ensure the continued confidential treatment of such Confidential Information. For matters subject to this Section 11.3.5 and Section 11.5, Section 11.5 shall control.

2.3.6 if the recipient Party is required to make a disclosure by Law, regulation or legal process, including by the rules or regulations of any tax authority, the United States Securities and Exchange Commission, or any other similar regulatory agencies in a country other than the United States or of any stock exchange or other securities trading institution. In such event, a Party disclosing Confidential Information of the other Party under this Section 11.3.6 shall disclose only such Confidential Information of such other Party as is required to be disclosed.

2.4 Performance; Regulatory Approvals. The Parties expressly agree that Novo shall have access to, and may submit, Confidential Information of Dicerna to any Regulatory Authority to the extent necessary for obtaining Regulatory Approvals for Products in the Field, and otherwise disclose Confidential Information concerning Collaboration Targets, Compounds and Products as it reasonably deems necessary or desirable in connection with Novo's exercise of its rights and performance of its obligations under this Agreement consistent with Novo's usual practices for protecting and disclosing confidential information relating to its products. The Parties expressly agree that Dicerna may submit Confidential Information of Novo to any Regulatory Authority to the extent necessary for obtaining Regulatory Approvals for Returned Compounds and Products in the Field. Confidential Information that is disclosed as permitted by this Section 11.4 shall, provided that such disclosure to the extent possible does not cause such Confidential Information to become known to the public or become part of the public domain, remain otherwise subject to the confidentiality and non-use provisions of Article 11, and the Party disclosing Confidential Information as permitted by this Section 11.4 shall take all steps reasonably necessary, including obtaining an order of confidentiality and otherwise cooperating with the other Party, to ensure the continued confidential treatment of such Confidential Information.

2.5 Disclosure of Agreement. This Agreement and the terms herein shall be considered the Confidential Information of each of the Parties and shall be treated confidentially by each of the Parties, except that either Party or its Affiliates may disclose the terms of this Agreement:

(a) to the extent required or advisable to comply with the rules and regulations promulgated by the United States Securities and Exchange Commission or any equivalent governmental agency in any country in the Territory, provided that such Party shall submit a confidential treatment request in connection with such disclosure and shall submit with such confidential treatment request only such redacted form of this Agreement as may be mutually agreed in writing by the Parties;

(b) to external counsel to *bona fide* prospective Acquirers who would only have access on a need-to-know basis, in a secure data room (which would contain documents that are water-marked and accessible on a time-stamped basis) following agreement on all material terms of the prospective transaction and would be restricted from sharing the terms with such counsel's client, provided that, either Party may disclose an unredacted form of this Agreement (including the foregoing information regarding Targets and payments) to the senior management of such prospective Acquirers, but only

at such time as (x) the Party wishing to so disclose such information certifies in writing to the other Party that such Party reasonably and in good faith believes, that it has reached agreement on all substantial economic terms and that it will execute a definitive agreement with respect to the proposed transaction within the following [* * *] and (y) the prospective Acquirer has executed a non-disclosure agreement restricting it to use such terms solely for purposes of evaluating the potential acquisition, restricting access to such individuals as may need to know the information for such evaluation, and strictly prohibiting disclosure of such terms by the prospective Acquirer;

(c) upon request from a Governmental Authority (such as tax authorities), provided the disclosing Party uses reasonable efforts to ensure the Governmental Authority maintains such terms as confidential;

(d) to applicable licensors, to the extent necessary to comply with the terms of any Third Party license agreement, the rights under which are sublicensed to the other Party under this Agreement; and,

(e) to the extent necessary to perform obligations or exercise rights under this Agreement, any sublicensee, collaborator or potential sublicensee or potential collaborator of such Party, provided that (i) any sublicensee, collaborator or potential sublicensee or collaborator agree in writing to be bound by obligations of confidentiality and non-use no less protective of the disclosing Party than those set forth in this Agreement; and (ii) the financial terms of this Agreement shall be redacted from any such disclosure of the terms of this Agreement.

2.6 Breaches of Confidentiality; Assistance in Respect of Same. The recipient Party shall promptly notify the disclosing Party if the recipient Party becomes aware of any breach of confidence or unauthorized use by any Person to whom the recipient Party has disclosed any Confidential Information. The recipient Party shall give the disclosing Party all reasonable assistance in connection with any action, demand, claim or proceeding that the disclosing Party may institute against any such person in respect of such disclosure.

2.7 Security. Each Party will make reasonable efforts concerning collection, use, analysis, retention, storage, protection, security, transfer, disclosure, disposal, and other processing of Novo Confidential Information will comply with, and will not violate, any (i) contractual obligation of the Party, (ii) any applicable laws, rules or regulations, including those relating to privacy and best practice (based on the size and scope of the applicable Party) data security, and/or (iii) internal or external written policy or privacy statement of such Party. Each Party has made Commercially Reasonable Efforts to implement and maintain reasonable administrative, physical, organizational, and technical safeguards sufficient to protect the Confidential Information processed by it, and such safeguards take into account the state of the art, are sufficient for the risks posed to the other Party's' Confidential Information. Each Party will notify the other Party as soon as possible after discovery of any unauthorized access to, or unpermitted or inappropriate use or disclosure of, the other Party's Confidential Information. Dicerna shall permit Novo to audit on reasonable notice and no more often than [* * *], under customary confidentiality obligations, of its compliance with the foregoing industry standard information technology requirements, to be conducted by Novo or Third Party experts appointed by Novo.

3. PUBLICATIONS AND PUBLICITY

3.1 **Publications**. Notwithstanding anything to the contrary in this Agreement, Novo shall have the right to publish the results of the R&D Program with respect to the Products, provided that any such publication shall be subject to the prior review of Dicerna and shall be provided at least [* * *] prior to its submission for publication. Dicerna will use diligent efforts to complete its review at least [* * *] prior to the intended publication date. Novo shall: (a) delete from such publication any of Dicerna's Confidential Information; or, (b) upon a determination that such publication includes patentable material, delay the submission of such publication or presentation for an additional period of up to [* * *] in order to allow the appropriate Party to pursue patent protection.

3.2 **Publicity**. The Parties have mutually approved a press release attached hereto as Exhibit D with respect to this Agreement and either Party may make subsequent public disclosure of the contents of such press release. Subject to the foregoing, each Party agrees not to issue any press release or other public statement, whether oral or written, disclosing the terms hereof or any of the activities under the R&D Program conducted hereunder without the prior written consent of the other Party; provided however, that neither Party will be prevented from complying with any duty of disclosure it may have pursuant to Applicable Laws or pursuant to the rules of any recognized stock exchange or quotation system subject to the restrictions set forth in Sections 11.3 and 11.5. In the event that Dicerna desires to make a public announcement regarding the achievement of any milestone event under Section 8.4 or Section 8.5, to the extent reasonably practicable, Dicerna will provide Novo with no less than [* * *] in which to review and approve such announcement, such approval not to be unreasonably withheld, conditioned or delayed.

4. HSR FILINGS AND CLOSING

4.1 **HSR Filings**. Promptly after the execution of this Agreement, both Parties shall file the appropriate notices with respect to the transactions contemplated hereby as promptly as reasonably practicable with the United States Federal Trade Commission ("**FTC**") and Department of Justice ("**DOJ**") under the Hart Scott Rodino Antitrust Improvements Act of 1976, as amended ("**HSR Act**"). Each of the Parties shall promptly supply the other with any information that may reasonably be required in order to effectuate the filings under the HSR Act. Each of the Parties shall notify the other promptly upon receipt from the FTC or DOJ in connection with any filing made under the HSR Act and of any request for amendments or supplements to any such filings or of any communications with, and any other inquiries or requests for additional information from, the FTC and DOJ. Each Party shall comply promptly, in accordance with advice received from counsel, as appropriate, with any such inquiry or request, provided, however, that neither Party shall be required to consent to the divestiture or other disposition of any of its assets or the assets of its Affiliates or to consent to any other structural or conduct remedy, and each Party and its Affiliates shall have no obligation to contest, administratively or in court, any ruling, order or other action of the FTC or DOJ or any Third Party with respect to the transactions contemplated by this Agreement. Each Party shall be responsible for paying its own costs and expenses (including legal and consultants' fees) incurred in connection with obtaining clearance of the transactions contemplated hereby from the FTC and the DOJ, except that Novo will pay the filing fees incurred by both Parties in connection with the filings required pursuant to the HSR Act. The Effective Date shall not be deemed to have occurred and this Agreement (other than this Article 13 and Articles 1, 11, 16 and

19 and Sections 2.4, 2.5 and 17.4) shall not be effective until the HSR Clearance Date. As used herein, the "**HSR Clearance Date**" means the earlier of (i) the date on which the FTC or DOJ shall notify the Parties of early termination of the waiting period under the HSR Act or (ii) the date on which the applicable waiting period under the HSR Act expires; provided, however, that if the FTC or DOJ commences any investigation by means of a second request or otherwise, HSR Clearance Date means the date on which any investigation opened by the FTC or DOJ has been terminated, without action to prevent the Parties from implementing the transactions contemplated by this Agreement with respect to the United States. Notwithstanding any other provisions of this Agreement to the contrary, either Party may terminate this Agreement effective upon Notice to the other Party if the HSR Clearance Date has not occurred on or before the date that is [* * *] after the Parties make their respective HSR filings.

4.2 Conduct Pending HSR Clearance Date. Between the date of execution of this Agreement and the earlier of the Effective Date or the date of termination, each Party shall conduct its business with respect to the intellectual property rights granted hereunder in the ordinary course, and it will refrain from taking any action or omitting to take any action that would have the effect of restricting or impairing the rights to be granted to either Party hereunder or preventing either Party's ability to perform its obligations under this Agreement.

5. TERM AND TERMINATION

5.1 Term. Subject to Article 13, the term of this Agreement (the "**Term**") will commence on the Signing Date (provided that this Agreement shall not become effective until the Effective Date, except as otherwise set forth in Section 13.1) and (subject to earlier termination in accordance with Section 14.3 or Section 14.2) will expire on a Product-by-Product (other than a Co-Development Product) basis upon the expiration of the Royalty Term for such Product. Upon expiration (but not earlier termination) of this Agreement with respect to a Product (other than a Co-Development Product), all rights and licenses granted to Novo hereunder shall become fully paid-up, royalty-free, perpetual and irrevocable with respect to such Product. The Term of this Agreement shall terminate on a Co-Development Product-by-Co-Development Product basis as set forth in Section 14.2.2.

5.2 Voluntary Termination.

5.2.1 Novo has the right to terminate the Agreement in its entirety or on a Collaboration Target-by-Collaboration Target, Compound-by-Compound, Product-by Product, or (with respect to Co-Development Products Directed to Collaboration Targets pursuant to Novo's exercise of its option under Section 2.3.2 or Section 3.3) Co-Development Product-by-Co-Development Product basis, without cause and in its sole discretion upon [* * *] prior written notice to Dicerna.

5.2.2 On or after the expiration of the Royalty Term that would have been applicable to a Co-Development Product if it had continued as a Royalty-bearing Product, either Party may terminate this Agreement with respect to such Co-Development Product upon written notice to the other Party. In such event, rights to such Co-Development Product shall revert to the non-terminating Party such that (1) if the non-terminating Party is Dicerna, the Co-Development Product shall

constitute a Returned Compound and Product under Sections 15.2.2 and 15.2.3, and (2) if the non-terminating Party is Novo, the provisions of Sections 15.2.2 and 15.2.3 shall apply to the benefit of Novo to the same extent that they are specified to apply to the benefit of Dicerna and Dicerna shall have the same obligations that Novo is specified as having, *mutatis mutandis*, provided that the exclusive license Novo receives under Section 15.2.3 shall be under all of the Licensed Technology and no negotiation is required in order for Novo to receive such license. Notwithstanding the foregoing, the royalties specified under Section 15.2.4 shall not apply to such reverted Co-Development Product. The Parties shall negotiate in good faith the royalties that will be payable by the non-terminating Party with respect to the reverted Co-Development Product. If the Parties are unable to agree on such royalties within [* * *] of the termination, then, at the request of either Party, the dispute shall be decided by binding arbitration as specified in Section 19.6 with the following modifications: there shall be only a single arbitrator, and within [* * *] after selection of the arbitrator, each Party shall submit to the arbitrator, and exchange with the other Party in accordance with a procedure to be established by the arbitrator, its case and proposal for a post-termination royalty structure applicable to the reverted Co-Development Product. Within [* * *] after receiving each Party's case and proposal, the arbitrators shall select, in its entirety and without modification, solely [* * *] of the [* * *] proposals submitted by the Parties.

5.3 Termination for Cause.

5.3.1 If a Party materially breaches this Agreement, the non-breaching Party may provide the breaching Party with a written notice specifying the nature of the breach and stating its intention to terminate this Agreement with respect to the Target(s), Compound(s) and/or Product(s) (as applicable) to which such breach directly relates if such breach is not cured as provided for in this Section 14.3.1. If the material breach is not cured by the allegedly breaching Party within [* * *] in the event of an undisputed payment default) after the receipt of such notice or if such other breach is curable but cannot be cured within the [* * *] period (which inability shall not apply to undisputed payment defaults) and the allegedly breaching Party fails to use diligent efforts to promptly cure such breach, or the allegedly breaching Party fails to dispute the alleged breach, within such [* * *] period, then in each case the non-breaching Party shall be entitled, without prejudice to any of its other rights under this Agreement, and in addition to any other remedies available to it by law or in equity, to terminate this Agreement with respect to the Target(s), Collaboration Targets, Compound(s) and/or Product(s) (as applicable) to which such breach directly relates by providing written notice to the other Party. If the allegedly breaching Party in good faith disputes such material breach or the failure to cure or remedy such material breach such Party shall, within [* * *] of receipt of written notice from the other Party of its intention to terminate: (x) provide written notice of that dispute putting forward in reasonable detail the rationale for disputing the alleged breach to the notifying Party and (y) initiate expedited arbitration procedures in accordance with Section 19.6, in which case, such termination shall not be effective until [* * *] after the arbitration award determining that the conditions for termination of this Section 14.2 are met; provided further that the breach is not cured within such [* * *] period. During the pendency of any such arbitration the Parties shall continue performing their respective obligations, and exercising their respective rights, under this Agreement. The Parties hereby agree to take such steps as may be reasonably necessary to complete such arbitration process as expeditiously as possible given the circumstances.

5.3.2 In the event that Dicerna or any of its Affiliates commences a declaratory judgment action, *inter partes* review, post-grant review, opposition or similar proceeding to challenge the validity or enforceability of any Product-Specific Patents, other than in response to a threat of an infringement claim or as necessary to secure allowance of a Novo-owned patent claim, such Patent Right shall no longer be a royalty-bearing Product-Specific Patent (but shall otherwise remain a Licensed Patent Right).

5.3.3 In the event that Novo or any of its Affiliates commences a declaratory judgment action, *inter partes* review, post-grant review, opposition or similar proceeding to challenge the validity or enforceability of any Licensed Patent Right, other than in response to a threat of an infringement claim or as necessary to secure allowance of a Dicerna-owned patent claim, and such action does not result in a declaration or ruling that the challenged Licensed Patent Right is invalid or unenforceable, Novo shall reimburse Dicerna for its out-of-pocket costs of defending such action and the Royalty rate on Products Covered by the challenged Licensed Patent Right shall be increased by [* * *] of the otherwise applicable Royalty rate set forth in Section 8.6.

5.3.4 In the event of any failure to make timely and complete payments by either Party under Section 5.4, including for Dicerna any adjustments of the Co-Development Percentage, the other Party shall have the right to terminate the relevant Co-Development Program.

5.4 Alternative to Termination. To the extent either Party acquires any right to terminate this Agreement with respect to any Target, Collaboration Target, Compound or Product (including Co-Development Targets and Co-Development Products) or Product-Specific Patent under Section 14.3.1, the non-breaching Party may, in lieu of such termination and without limiting any other rights and remedies, elect for this Agreement to continue in full force and effect with respect to such Target, Collaboration Target, Compound, Product or Product-Specific Patent (as applicable); provided, however, that in the event Novo acquires such termination right due to Dicerna's breach of any of its obligations under Sections 3.1 and 3.2, Novo shall have the additional right, at its election upon notice to Dicerna, to either (a) have any and all amounts thereafter payable by Novo hereunder relating to or in any way connected with the applicable Target, Collaboration Target, Compound or Product, or the Product(s) Covered by the applicable Product-Specific Patent, for which Novo made such election under this Section 14.4 reduced by [* * *] or (b) seek damages through dispute resolution in accordance with Section 19.6. With respect to any such reduction relating to a Co-Development Product, Dicerna's obligation to pay Post-Option Development Expenses shall also be reduced by [* * *]. For the avoidance of doubt, the non-breaching Party acquiring a right to terminate is not required to choose between exercising such termination right and such reduction right, and if the non-breaching Party elects to terminate this Agreement it may also seek damages through dispute resolution in accordance with Section 19.6.

6. EFFECTS OF TERMINATION

6.1 Termination of Agreement. If this Agreement terminates in full for any reason other than expiration, then no later than [* * *] after the effective date of such termination, Novo shall pay all amounts then due and owing (except that Novo shall have the right to offset any undisputed monies owed to Novo by Dicerna, if any) as of the termination date and each Party shall return or cause to be returned to the other Party, or destroy, the other Party's Confidential Information and all copies thereof unless such Confidential Information are included within the scope of any ongoing license under Section 15.2.3; provided, however, that each Party may keep [* * *] copy of the other Party's Confidential Information in its confidential files for record purposes and such copy shall remain subject to Article 11 of this Agreement. In the event of termination of this Agreement, except as expressly set forth otherwise in this Agreement (including under the surviving provisions set forth in Section 15.3), the rights and obligations (including the licenses granted under Article 7, except for the mutual use of Confidential Information under Section 7.6, which shall survive) of the Parties hereunder shall terminate as of the date of such termination.

6.2 Target/Product Return.

6.2.1 Upon any Target becoming a Discontinued Target, voluntary termination of this Agreement in its entirety under Section 14.2 or with respect to particular Compounds, Products or Collaboration Targets under Section 14.2 or Section 14.3, any license rights granted by Dicerna to Novo to the Discontinued Target or affected Products, as applicable, (or rights to all Collaboration Targets in the event of the termination of this Agreement as a whole) shall cease and revert to the respective Parties. For purposes of this Section 15.2, "**Returned Compounds and Products**" shall mean, in the case of a Collaboration Target or Co-Development Target becoming a Discontinued Target, all Product(s) and Compound(s) then being Developed under this Agreement that are Directed To such Discontinued Target(s). Discontinued Targets and Returned Compounds and Products will no longer be subject to Sections 3.1 and 3.2. If this Agreement is terminated by either Party pursuant to Section 13.1, the Parties acknowledge and agree that (a) no Target shall ever have been deemed to be a Collaboration Target, (b) the licenses herein shall be deemed to have never granted and (c) neither Party shall have been subject to any exclusivity obligations.

6.2.2 Novo shall, at Dicerna's request, transfer to Dicerna the following items with respect to Returned Compounds and Products, to the extent necessary and to the extent used by Novo (as of the date of termination) for the Development, registration, Manufacture (including formulation), use, or Commercialization of the Returned Compounds and Products: all clinical and regulatory correspondence; all Regulatory Approvals held by Novo or its Affiliates; all data and results arising from Novo's Development or Commercialization of the Compounds and Products corresponding to the Returned Compounds and Products, including the trial master file, the clinical database and the safety database; and solely related to the Compounds and Products that are transferable by Novo or its Affiliates to Dicerna; provided, however, that Novo shall have the right to retain copies of the foregoing information and documentation and information and documentation generally. Dicerna shall (i) reimburse Novo for its reasonable out-of-pocket costs associated with such transfer, as defined in an invoice to be provided by Novo to Dicerna promptly following the effective date of termination in the event of a termination by Novo for Dicerna's material breach pursuant to Section 14.3; and (ii) assume financial responsibility for such items from the date of transfer to Dicerna. All Confidential Information of Novo relating to the items transferred pursuant hereto shall become joint Confidential Information following such transfer; provided that Dicerna shall have the right to use and disclose such Confidential Information as it reasonably deems necessary or desirable in connection with research, development and commercialization of Returned Compounds and Products incorporating such Confidential Information consistent with Dicerna's usual practices for protecting and disclosing confidential information relating to its products.

6.2.3 [* * *]. The Parties will agree in good faith regarding a technology transfer plan to facilitate Dicerna's practice of the foregoing licenses, which plan will provide for reasonable reimbursement to Novo for Novo's actual internal and out-of-pocket costs and expenses, except in the event Dicerna terminates pursuant to Section 14.3 (in which case the costs and expenses of such transfer shall be borne by Novo), and Dicerna shall be solely responsible, in its discretion, for the prosecution, maintenance, defense and enforcement or all Product-Specific Patents and Novo Product Patents. Any sublicense granted by Novo or its Affiliate to a Third Party under the license granted under Section 7.1 shall survive the termination of this Agreement, provided that, in the case

where termination of this Agreement for Novo's uncured material breach pursuant to Section 14.3, such sublicensee did not cause such uncured material breach. If permitted under such a surviving sublicense, effective upon termination of this Agreement, such sublicense shall become a direct license from Dicerna to such sublicensee; provided, that, if assignment of the sublicense or such conversion of the sublicense to a direct license is not permitted under the applicable sublicense, Novo shall be entitled to retain its right to payment thereunder and shall remain liable for Royalties under Section 8.6 of this Agreement with respect to sales by such sublicensee. If Novo will be required to pay a Third Party licensing fees based on the grant of a sublicense to Dicerna of the applicable intellectual property, Novo shall notify Dicerna of such requirement in advance and Dicerna shall have the option of either not receiving such sublicense or of receiving such sublicense and becoming responsible for the licensing fees and other payments that become payable as a result of such sublicense to Dicerna. In addition, if Dicerna reasonably believes that Dicerna requires a license under Novo Background IP in order to Develop or Commercialize Returned Compounds and Products and requests that Novo negotiate with Dicerna a license under such Novo Background IP for such Development and Commercialization, Novo shall negotiate in good faith with Dicerna with respect to such requested license.

6.2.4 [* * *].

6.2.5 For clarity, with the exception of applicable obligations under this Section 15.2 and without limiting Section 15.4 and unless expressly agreed otherwise, all obligations of the Parties with respect to the Research, Development and Commercialization of the Collaboration Targets, Compounds, and Products shall terminate on the date of notice of termination of this Agreement.

6.3 **Survival**. Termination or expiration of this Agreement shall not relieve Novo or Dicerna of any obligation accruing prior to such termination/expiration, nor affect in any way the survival of any other right, duty or obligation of Novo or Dicerna which is expressly stated elsewhere in this Agreement to survive such termination. Without limiting the foregoing and except as expressly set forth otherwise in this Agreement, Article 1 (for definitional purposes), Articles 8 and 9 (to the extent that any amounts payable accrued prior to the effective date of such expiration/termination and remain unpaid), Article 11, Article 15 and Article 17 (to the extent and with respect to claims accruing or arising prior to the effective date of such termination), Article 18 (to the extent arising prior to the effective date of termination) and Section 2.4 (but only with respect to information disclosed prior to the notice of termination), Section 8.6 (but only applicable with respect to sublicenses surviving termination (not an expiration) as described in Section 15.2.3 and further, only after First Commercial Sale of a Product and to the extent such sublicensee continues to Develop or Commercialize a Product that triggers such payment obligations during the Royalty Term), Sections 10.1, 10.3 through 10.6, 10.7.3, 10.8, 10.11, and 10.12 (but only to the extent and with respect to intellectual property generated/developed prior to the effective date of such termination), and Sections 2.3.5, 3.4 (to the extent any Compounds, Products, Collaboration Targets or Co-Development Products are still being Researched, Developed or Commercialized), 4.6.1, 7.6, 7.7, 7.8, 9.4, 9.5, 10.7.1, 10.13, 12.2, 14.1, 14.2.2, 15.2, and 16.3 shall survive termination, and Sections 19.1, 19.3 through 19.23 shall survive to the extent applicable. Except as otherwise expressly

provided herein, all other rights and obligations of the Parties under this Agreement shall terminate upon termination/expiration of this Agreement.

6.4 Termination Not Sole Remedy. Termination of this Agreement is not the sole remedy under this Agreement and, whether or not termination is effected, all other remedies will remain available (except as Novo and Dicerna have expressly agreed to otherwise herein) and such termination shall not preclude Novo and Dicerna from claiming any other damages, compensation or relief that it may be entitled to upon such termination.

6.5 Bankruptcy Code. If this Agreement is rejected by a Party as a debtor under Section 365 of the United States Bankruptcy Code or similar provision in the bankruptcy laws of another jurisdiction (the "**Code**"), then, notwithstanding anything else in this Agreement to the contrary, all licenses and rights to licenses granted under or pursuant to this Agreement by the Party in bankruptcy to the other Party are, and shall otherwise be deemed to be, for purposes of Section 365(n) of the Code (or similar provision in the bankruptcy laws of the jurisdiction), licenses of rights to "intellectual property" as defined under Section 101(35A) of the Code (or similar provision in the bankruptcy laws of another applicable jurisdiction). The Parties agree that a Party that is a licensee of rights under this Agreement shall retain and may fully exercise all of its rights and elections under the Code, and that upon commencement of a bankruptcy proceeding by or against a Party under the Code, the other Party shall be entitled to a complete duplicate of, or complete access to (as such other Party deems appropriate), any such intellectual property and all embodiments of such intellectual property, if not already in such other Party's possession, shall be promptly delivered to such other Party (a) upon any such commencement of a bankruptcy proceeding upon written request therefor by such other Party, unless the bankrupt Party elects to continue to perform all of its obligations under this Agreement or (b) if not delivered under the foregoing subclause (a), upon the rejection of this Agreement by or on behalf of the bankrupt Party upon written request therefor by the other Party. The foregoing provisions of this Section 15.5 are without prejudice to any rights a Party may have arising under the Code.

7. REPRESENTATIONS AND WARRANTIES

7.1 Representations and Warranties by Each Party. Each Party represents and warrants to the other as of the Signing Date that:

7.1.1 Good Standing. It is a corporation duly organized, validly existing under the laws of the jurisdiction of its incorporation, and in good standing under the laws of its jurisdiction of formation;

7.1.2 Authority and Capabilities. It has: (a) full corporate power and authority to execute, deliver, and perform this Agreement; (b) taken all corporate action(s) required by Applicable Laws and its organizational documents to authorize the execution and delivery of this Agreement, and the consummation of the transactions and performance of its obligations contemplated by this Agreement; and, (c) sufficient facilities, experienced personnel or other capabilities (including *via* Affiliates and/or Third Parties) to enable it to perform its obligations under this Agreement;

7.1.3 Valid and Binding. This Agreement constitutes a legal, valid and binding agreement enforceable against it in accordance with its terms (except as the enforceability thereof may be limited by bankruptcy, bank moratorium or similar laws affecting creditors' rights generally and laws restricting the availability of equitable remedies and may be subject to general principles of equity whether or not such enforceability is considered in a proceeding at law or in equity);

7.1.4 No Conflict. The execution and delivery of this Agreement and all other instruments and documents required to be executed pursuant to this Agreement, and the consummation of the transactions contemplated hereby do not and shall not: (a) conflict with or result in a breach of any provision of its organizational documents; (b) result in a breach of any agreement to which it is a party; or, (c) violate any Applicable Laws;

7.1.5 Absence of Debarment. Neither Party, its officers, employees, agents, consultants or any other person used by such Party in the performance of the respective Research and Development activities under the R&D Program has been or is: (a) debarred, convicted, or is subject to a pending debarment or conviction, pursuant to section 306 of the United States Federal Food, Drug, and Cosmetic Act ("**FFDCA**"), 44 U.S.C. § 335a; (b) listed by any government or regulatory agencies as ineligible to participate in any government healthcare programs or government procurement or non-procurement programs (as that term is defined in 42 U.S.C. 1320a-7b(f)), or excluded, debarred, suspended or otherwise made ineligible to participate in any such program; or, (c) convicted of a criminal offense related to the provision of healthcare items or services, or is subject to any such pending action. A Party agrees to inform the other Party in writing promptly if a Party or any person who is performing activities under the R&D Program is subject to the foregoing, or if any action, suit, claim, investigation, or proceeding relating to the foregoing is pending, or to the best of such Party's knowledge, is threatened.

7.1.6 Regulatory Documentation. With respect to the Product(s), each Party and its Affiliates shall generate, prepare, maintain and retain all Regulatory Documentation that is required to be maintained or retained by such Party and its Affiliates pursuant to and in accordance with, to the extent applicable, good laboratory and clinical practice and Applicable Law and all such information shall be true, complete and correct in all material respects and what it purports to be. "**Regulatory Documentation**" means: all (i) applications (including all INDs and applications for Regulatory Approval), registrations, licenses, authorizations and approvals (including Regulatory Approvals); (ii) correspondence and reports submitted to or received from Regulatory Authorities (including minutes and official contact reports relating to any communications with any Regulatory Authority) and all supporting documents with respect thereto, including all adverse event files and complaint files; (iii) supplements or changes to any of the foregoing following Regulatory Approval; and (iv) clinical and other data, including Clinical Trial data, contained or relied upon in any of the foregoing; in each case ((i), (ii), (iii) and (iv)) relating to the Product(s) Directed To a Collaboration Target.

7.1.7 Assignment by Employees, Agents and Consultants. All employees and agents of, and consultants to, each Party or its Affiliates are obligated to assign to such Party or its Affiliate their rights in and to any inventions arising out of their work at such Party or its Affiliate either pursuant to written agreement or by operation of law.

7.1.8 Actions Regarding Regulatory Authorities. Neither Party nor any of its Affiliates, nor any of its or their respective officers, employees or agents has: (i) committed (or after the Signing Date, will commit) an act, (ii) made (or after the Signing Date, will make) a statement or (iii) failed (or after the Signing Date, will fail) to act or make a statement that, in any case ((i), (ii) (iii)), that (x) would be or create an untrue statement of material fact or fraudulent statement to the FDA or any other Regulatory Authority with respect to the Commercialization of Products or (y) could reasonably be expected to provide a basis for the FDA to invoke its policy respecting "Fraud, Untrue Statements of Material Facts, Bribery and Illegal Gratuities", set forth in 56 Fed. Reg. 46191 (September 10, 1991) and any amendments thereto or any analogous laws or policies in the Territory, with respect the Commercialization of Compounds or Products.

7.1.9 Limitation. Neither Party nor its Affiliates makes any representation or warranty, either express or implied, that any of the R&D Program, Research, Development and/or Commercialization efforts with regard to any Compound or Product will be successful.

7.2 **Representations, Warranties and Covenants by Dicerna**. Dicerna represents, warrants and, as applicable, covenants, to Novo as follows:

7.2.1 **No Targets Encumbered**. As of the Signing Date, the Blocked Target List is comprised of only the Blocked Targets disclosed pursuant to Section 2.3.1.

7.2.2 **No Conflict with this Agreement**. Neither Dicerna nor any of its Affiliates has granted, nor will Dicerna or its Affiliates grant during the Term, any rights (or other encumbrances) to any Third Party to Licensed Technology that conflict with the rights assigned and/or granted to Novo hereunder. Dicerna has Control over all Know-How and Patent Rights owned by it or its Affiliates as of the Signing Date that are necessary or reasonably useful to the Research, Development, registration, manufacturing (including formulation) or Commercialization of the Compounds and Products as known to be contemplated by this Agreement as of the Signing Date. Dicerna shall ensure that: (a) all Know-How relating to, and Patent Rights directed to (i) the GalXC Platform or (ii) Compounds and Products, necessary or reasonably useful to Research, Develop, register, Manufacture (including formulate), use or Commercialize Compounds or Products in the Field in the Territory; and (b) all Improvements to Licensed Technology; in each case of (a) and (b) solely conceived, developed, created, made or reduced to practice by Dicerna or its Affiliates and not subject to Third Party rights under existing agreements, except for the Blocked Targets and Targets subject to the Excluded Field due to exclusivity obligations granted under the Lilly Agreement consistent with this Section 16.2.2, are upon creation and remain thereafter Controlled by Dicerna. Neither Dicerna, nor any of its Affiliates, will enter into any agreement after the date of execution of this Agreement conflicting with the foregoing. Neither Dicerna nor any of its Affiliates will assign, divest or otherwise transfer any of the Licensed Technology in a manner that would adversely affect Novo's rights hereunder. Neither Dicerna nor any of its Affiliates has, in anticipation of this Agreement or one of a similar nature, participated in, or agreed or planned to participate in, any transaction or series of transactions where the intent or result of such transaction(s) is (or was) to avoid extending to Novo or its Affiliates any benefits of this Agreement that Novo and its Affiliates otherwise would have enjoyed, and Dicerna shall

not, and shall cause its Affiliates not to, participate in, or agree or plan to participate in, any such transaction following the Signing Date.

7.2.3 Existing Patent Rights.

(a) All Patent Rights contained in the Licensed Technology existing as of the Signing Date that are issued or subject to a pending application for issuance (the "**Existing Patents**") are listed on Exhibit E and all such Existing Patents are, as of the Signing Date: (i) to the extent issued (unless otherwise indicated on Exhibit E), subsisting and, to Dicerna's knowledge, not invalid or unenforceable; (ii) except for the Blocked Targets or Targets subject to the Excluded Field due to the exclusivity obligations granted under the Lilly Agreement, solely and exclusively owned or exclusively licensed to Dicerna in the Field in the Territory, free of any encumbrance, lien or claim of ownership by any Third Party; (iii) to the extent subject to a pending application for issuance, being prosecuted in the respective patent offices in which such applications have been filed in accordance with Applicable Law and Dicerna's ordinary patent prosecution practices and Dicerna and its Affiliates have presented all relevant references, documents and information of which it and the inventors are aware and which is advisable based on advice from patent counsel to the relevant patent examiner at the relevant patent office; and (iv) filed and maintained properly and all applicable fees applicable thereto have been paid on or before the due date for payment.

(b) As of the Signing Date, to Dicerna's Knowledge, neither Dicerna nor any of its Affiliates have taken any action that would render any Invention claimed in the issued Existing Patents unpatentable.

(c) The Existing Patents represent all Patent Rights Controlled by Dicerna or their Affiliates as of the Signing Date that are necessary or reasonably useful for the Research, Development, or Commercialization of the Compounds and Products as known to be contemplated by this Agreement as of the Signing Date. To Dicerna's knowledge, as of the Signing Date, no rights or licenses are required under any Third Party Patent Rights or Know-How for Novo to Research, Develop, Manufacture (including to formulate) or Commercialize the Products as contemplated herein as of the Signing Date other than those granted under Section 7.1.

(d) There is no license or other right granted by Dicerna or any of its Affiliates to any Third Party, or any agreement with a Third Party to which Dicerna or any of its Affiliates is a party, that would cause any Patent Right or Know-How generated by or on behalf of Dicerna or any of its Affiliates in the conduct of activities under this Agreement to fail to be Licensed Technology by depriving Dicerna of Control of such Patent Right or Know-How in the Field.

7.2.4 Litigation and Actions Relating to Intellectual Property. As of the Signing Date: (a) Dicerna has not received any written notice of any threatened claims or litigation seeking

to invalidate or otherwise challenge the Licensed Technology, including the Licensed Patent Rights, or Dicerna's or its Affiliates' rights, therein; and (b) Dicerna is not aware of any pending or threatened action, suit, proceeding or claim by a Third Party asserting that Dicerna or its Affiliates is infringing or has misappropriated or otherwise is violating any Patent Right, trade secret or other proprietary right of any Third Party as would reasonably be expected to impair in any material respect the ability of it or its Affiliates to fulfill any of its obligations under this Agreement.

7.2.5 Other Material Claims and Actions. As of the Signing Date, there are no claims, actions, or proceedings pending or, to Dicerna's of its Affiliates' knowledge, threatened; nor, to Dicerna's or its Affiliates' knowledge, are there any formal inquiries initiated or written notices received for any such legal proceedings, in each case (or in aggregate) against Dicerna or its Affiliates or their properties, assets or businesses, which if adversely decided, would, individually or in the aggregate, have a material adverse effect on, or prevent Dicerna's or its Affiliates' ability to conduct the R&D Program or to grant the licenses or rights granted under this Agreement.

7.2.6 No Government Funding. The Inventions claimed by the Existing Patents as of the Signing Date: (i) were not conceived, discovered, developed or otherwise made in connection with any research activities funded, in whole or in part, by the federal government of the United States of America or any agency thereof and (ii) are not a "subject invention" as that term is described in 35 U.S.C. Section 201(e) and (iii) are not otherwise subject to the provisions of the Patent and Trademark Law Amendments Act of 1980, as amended, codified at 35 U.S.C. §§ 200-212, as amended, as well as any regulations promulgated pursuant thereto, including in 37 C.F.R. Part 401.

7.3 No Other Warranties. Except as otherwise expressly set forth in this Agreement, each Party and its Affiliates expressly disclaim any and all representations or warranties of any kind with respect to the subject matter of this Agreement, whether express or implied, including any warranties of non-infringement, merchantability or fitness for a particular purpose.

8. INDEMNIFICATION AND LIABILITY

8.1 Indemnification by Dicerna. Dicerna shall indemnify, defend and hold Novo and its Affiliates, and their respective officers, directors, employees and agents (each, a "**Novo Indemnified Party**"), harmless from and against losses, settlements, penalties, fines, costs or expenses, damages and liability, including reasonable legal expense and attorneys' fees, (collectively, "**Losses**") to which any Novo Indemnified Party may become subject as a result of any Third Party demands, suits, claims or actions ("**Claims**") against any Novo Indemnified Party (including product liability claims) arising or resulting from: (a) the Research, Development, Manufacture (including formulation), Commercialization or other exploitation of the Dicerna Orphan Products and Returned Compounds and Products pursuant to this Agreement by or on behalf of Dicerna or its Affiliates; (b) the negligence or willful misconduct of Dicerna or its Affiliates pursuant to this Agreement; (c) the breach of any term in or the covenants, warranties, representations made by Dicerna to Novo under this Agreement; (d) misappropriation of a Third Party's Know-How to the extent such misappropriation arises from Novo's, its Affiliate's or its or their sublicensees' use hereunder of materials provided by a Dicerna Indemnified Party hereunder. Dicerna is only obliged to so indemnify and hold the Novo Indemnified Parties harmless to the extent that such

Claims: (i) do not arise from any breach of this Agreement or the negligence or willful misconduct of a Novo Indemnified Party and/or (ii) are not subject to indemnification by Novo under Section 17.2.

8.2 Indemnification by Novo. Novo shall indemnify, defend and hold Dicerna and its Affiliates, and their respective officers, directors, employees and agents (each, a "**Dicerna Indemnified Party**"), harmless from and against Losses incurred by any Dicerna Indemnified Party as a result of any Third Party Claims against any Dicerna Indemnified Party (including product liability claims) arising or resulting from: (a) the Research, Development, Manufacture (including formulation), Commercialization or other exploitation of the Compounds and Products (but not the Co-Development Products) pursuant to this Agreement by or on behalf of Novo or its Affiliates (other than to the extent Dicerna or its Affiliates are carrying out work on behalf of Novo, but subject to subclause (d)), (b) the negligence or willful misconduct of Novo or its Affiliates pursuant to this Agreement; (c) the breach of any term in or the covenants, warranties, representations made by Novo to Dicerna under this Agreement or (d) misappropriation of a Third Party's Know-How to the extent such misappropriation arises from Dicerna's, its Affiliate's or its or their sublicensees' use hereunder of materials provided by a Novo Indemnified Party hereunder. Novo is only obliged to so indemnify and hold the Dicerna Indemnified Parties harmless to the extent that such Claims: (i) do not arise from any breach of this Agreement or the negligence or willful misconduct of a Dicerna Indemnified Party and/or (ii) are not subject to indemnification by Dicerna under Section 17.1.

8.3 Indemnification Procedure.

8.3.1 Any Novo Indemnified Party or Dicerna Indemnified Party seeking indemnification hereunder ("**Indemnified Party**") shall notify the Party against whom indemnification is sought ("**Indemnifying Party**") in writing reasonably promptly after the assertion against the Indemnified Party of any Claim in respect of which the Indemnified Party intends to base a claim for indemnification hereunder, but the failure or delay so to notify the Indemnifying Party shall not relieve the Indemnifying Party of any obligation or liability that it may have to the Indemnified Party except to the extent that the Indemnifying Party demonstrates that its ability to defend or resolve such Claim is adversely affected thereby.

8.3.2 Subject to the provisions of Section 17.3.3, the Indemnifying Party shall have the right, upon providing notice to the Indemnified Party of its intent to do so within [* * *] after receipt of the notice from the Indemnified Party of any Claim, to assume the defense and handling of such Claim, at the Indemnifying Party's sole expense. If the Indemnifying Party does not assume control of such defense, or does not comply with its obligations under Section 17.3.3, the Indemnified Party shall be entitled to control the defense and handling of the Claim at the Indemnifying Party's sole expense.

8.3.3 If the Indemnifying Party elects to assume the defense and handling of the Claim: (a) the Indemnifying Party shall select competent counsel in connection with conducting the defense and handling of such Claim, and the Indemnifying Party shall defend or handle the same in consultation with the Indemnified Party, and shall keep the Indemnified Party timely apprised of the status of such Claim; (b) the Indemnifying Party shall not, without the prior written consent

of the Indemnified Party, agree to a settlement of any Claim which could lead to liability or create any financial or other obligation on the part of the Indemnified Party for which the Indemnified Party is not entitled to indemnification hereunder, or would involve any admission of wrongdoing on the part of the Indemnified Party; and (c) the Indemnified Party shall cooperate with the Indemnifying Party, at the request and expense of the Indemnifying Party, shall be entitled to participate in the defense and handling of such Claim with its own counsel and at its own expense, and shall not agree to any settlement of the Claim without the prior written consent of the Indemnifying Party if there is any liability or any financial or other obligation on the part of the Indemnifying Party or if it would adversely affect the Indemnifying Party.

8.4 SPECIAL, INDIRECT, AND OTHER LOSSES. NEITHER PARTY NOR ANY OF ITS AFFILIATES SHALL BE LIABLE UNDER THIS AGREEMENT FOR SPECIAL, INDIRECT, INCIDENTAL, PUNITIVE OR CONSEQUENTIAL DAMAGES, INCLUDING LOSS OF PROFITS SUFFERED BY THE OTHER PARTY, EXCEPT FOR: (A) LIABILITY FOR BREACH OF ARTICLE 7; (B) DAMAGES REQUIRED TO BE PAID TO (I) A THIRD PARTY PURSUANT TO A NON-APPEALABLE ORDER OF A COURT OF COMPETENT JURISDICTION IN CONNECTION WITH A THIRD PARTY CLAIM FOR WHICH THE INDEMNIFIED PARTY IS ENTITLED TO INDEMNIFICATION HEREUNDER OR (II) A PARTY PURSUANT TO A NON-APPEALABLE ORDER OF A COURT OF COMPETENT JURISDICTION IN CONNECTION WITH A VIOLATION OF PATENT RIGHTS OR OTHER INTELLECTUAL PROPERTY RIGHTS; (C) SUCH DAMAGES ARISING OUT OF ANY BREACH OF SECTIONS 3.1 OR 3.2 OR 3.4 OR ARTICLE 11 OF THIS AGREEMENT BY A PARTY, ITS AFFILIATES OR SUBLICENSEES; OR (D) SUCH DAMAGES ARISING OUT OF THE GROSS NEGLIGENCE OR WILLFUL MISCONDUCT OF THE LIABLE PARTY.

8.1 Insurance. [* * *].

9. COMPLIANCE

9.1 Compliance with this Agreement. Each of the Parties shall, and shall (to the extent applicable) cause their respective Affiliates to, comply in all material respects with the terms of this Agreement.

9.1 Compliance with Party Specific Regulations. In carrying out their respective obligations under this Agreement, the Parties agree to cooperate with each other as may reasonably be required to help ensure that each is able to fully meet its obligations with respect to the Party Specific Regulations applicable to it. Neither Party shall be obligated to pursue any course of conduct that would result in such Party being in material breach of any Party Specific Regulation applicable to it; provided that in the event that a Party refuses or is unable to fulfill its obligations under this Agreement in any material respect on such basis, the other Party shall (without derogation to any other available rights and remedies) have the right to terminate this Agreement in accordance with Section 14.3. All Party Specific Regulations are binding only in accordance with their terms and only upon the Party to which they relate.

9.2 Compliance with Internal Compliance Codes. Except as expressly set forth in this Agreement, all Internal Compliance Codes shall apply only to the Party to which they relate. The Parties agree to cooperate with each other to help insure that each Party is able to comply with the substance of its respective Internal Compliance Codes and, to the extent practicable, each Party shall operate in a manner consistent with its Internal Compliance Codes applicable to its performance under this Agreement.

9.3 Compliance with Anti-Corruption Laws. In connection with this Agreement, the Parties shall comply with all applicable local, national, and international laws, regulations, and industry codes dealing with government procurement, conflicts of interest, corruption or bribery, including, if applicable, the US Foreign Corrupt Practices Act of 1977, as amended, and any laws enacted to implement the Organization of Economic Cooperation and Development Convention on Combating Bribery of Foreign Officials in International Business Transactions.

9.4 Prohibited Conduct. Without limiting the other obligations of the Parties set forth in this Article 18, in connection with any activities of the Parties under this Agreement, the Parties confirm that they have not made, offered, given, promised to give, or authorized, and will not make, offer, give, promise to give, or authorize, any bribe, kickback, payment or transfer of anything of value, directly or indirectly, to any person or to any Government Official for the purpose of: (i) improperly influencing any act or decision of the person or Government Official; (ii) inducing the person or Government Official to do or omit to do an act in violation of a lawful or otherwise required duty; (iii) securing any improper advantage; or, (iv) inducing the person or Government Official to improperly influence the act or decision of any organization, including any government or government instrumentality, to assist any Party in obtaining or retaining business. For the purposes of this Section "Government Official" means: (i) any officer or employee of: (a) a government, or any department or agency thereof; (b) a government-owned or controlled company, institution, or other entity, including a government-owned hospital or university; or (c) a public international organization (such as the United Nations, the International Monetary Fund, the International Committee of the Red Cross, and the World Health Organization), or any department or agency thereof; (ii) any political party or party official or candidate for public or political party office; and/or (iii) any person acting in an official capacity on behalf of any of the foregoing.

9.5 Responsible Business. Each Party will work to improve its social, environmental and ethical procedures, policies and performance and will support the principles set out in the United Nations' Universal Declaration of Human Rights of 1948, the International Labour Organization Conventions and the ICC Business Charter for Sustainable Developments (hereinafter jointly referred to as "Responsible Business Practices"). Each Party undertakes to promptly notify the other Party if it encounters difficulties in supporting Responsible Business Practices. Upon request and within a reasonable period of time, each Party will discuss with the other Party information on its social, environmental and ethical procedures, policies and performance in order to reasonably substantiate that Responsible Business Practices are being followed. If, based on such discussion, a Party appears to face difficulties in supporting Responsible Business Practices, the Parties agree to collaborate in good faith to address any such difficulties as the exclusive remedy therefor.

10. GENERAL PROVISIONS

10.1 Assignment. Except as provided in this Section 19.1, [* * *].

10.1 Effects of Assignment, Change of Control. In the event of any assignment of this Agreement by Dicerna or upon a Change of Control of Dicerna:

10.1.1 Dicerna's rights subsequent to a Change of Control to designate Products as Co-Development Products under Sections 2.3.2 and 2.3.3 shall [* * *];

10.1.2 Novo may terminate Dicerna's rights to participate in any Commercialization (including co-promotion) activities with respect to any Co-Development Products;

10.1.3 Novo shall have no obligations under this Agreement to provide to Dicerna any sensitive information or materials, including information or materials relating to sales, marketing, development or strategic matters;

10.1.4 Dicerna's rights as an Auditing Party under Section 9.5 shall be limited to auditing Novo's books and records to determine the accuracy of Net Sales and Operating Profit or Loss calculations;

10.1.5 [* * *];

10.1.6 Novo shall have the right to terminate the JSC and/or any of its Working Groups, in which case all authority granted to the JSC and any such Working Groups shall vest in Novo; and

10.1.7 If Dicerna owes any deferred amount under Section 5.4.2(b), Dicerna shall repay to Novo such deferred amount prior to or on the date of such assignment or Change of Control of Dicerna.

10.2 Extension to Affiliates. Except as expressly set forth otherwise in this Agreement, each Party shall have the right to extend the rights and immunities granted in this Agreement to one or more of its Affiliates. All applicable terms and provisions of this Agreement, except this right to extend, shall apply to any such Affiliate to which this Agreement has been extended to the same extent as such terms and provisions apply to the Party extending such rights and immunities. For clarity, the Party extending the rights and immunities granted hereunder shall remain primarily liable for any acts or omissions of its Affiliates.

10.3 Severability. Should one or more of the provisions of this Agreement become void or unenforceable, or be determined to be void or unenforceable, as a matter of Applicable Laws, then this Agreement shall be construed as if such provision were not contained herein and the remainder of this Agreement shall be in full force and effect, and the Parties will use their best efforts to substitute for the invalid or unenforceable provision a valid and enforceable provision which conforms as nearly as possible with the original intent of the Parties.

10.4 Governing Law; English Language. This Agreement shall be governed by and construed in accordance with the laws of the State of New York and the patent laws of the United States without giving effect to any law that would result in the application of a different body of

law than as set forth in this Section 19.5. This Agreement was prepared in the English language, which language shall govern the interpretation of, and any dispute regarding, the terms of this Agreement.

10.5 Dispute Resolution.

10.5.1 If any dispute, claim or controversy of any nature arising out of or relating to this Agreement, including any action or claim based on tort, contract or statute, or concerning the interpretation, effect, termination, validity, performance or breach of this Agreement (each, a "**Dispute**"), arises between the Parties and the Parties cannot resolve such Dispute through their respective Project Leaders, Program Leaders or JSC, if and as applicable, within [* * *] of a written request by either Party to the other Party ("**Notice of Dispute**"), and such Dispute is not one for which a Party has final decision-making as expressly set forth in Section 6.5.4 of this Agreement, either Party may refer the Dispute to Senior Representatives of each Party for resolution. Each Party, within [* * *] after a Party has received such written request from the other Party to so refer such Dispute, shall notify the other Party in writing of the Senior Representative to whom such dispute is referred. If, after an additional [* * *] after the Notice of Dispute, such Senior Representatives have not succeeded in negotiating a resolution of the Dispute, and a Party wishes to pursue the matter, each such Dispute, controversy or claim that is not an "Excluded Claim" (defined in Section 19.6.5) shall be finally resolved by binding arbitration by the International Chamber of Commerce ("ICC") administered in accordance with Rules of ICC in effect on the date of this Agreement and applying the substantive law specified in Section 19.5. Judgment on the arbitration award may be entered in any court having jurisdiction thereof. The obligation to arbitrate under this Section 19.6 shall extend to any claims by or against the Parties and their respective Affiliates and any agents, principals, officers, directors, or employees of either of the Parties or their respective Affiliates.

10.5.2 The arbitration shall be conducted by: [* * *] experienced in the business of pharmaceuticals. If the issues in dispute involve scientific, technical or commercial matters, the arbitrators chosen hereunder shall engage experts that have educational training or industry experience sufficient to demonstrate a reasonable level of relevant scientific, medical and industry knowledge, as necessary to resolve the dispute. Within [* * *] after initiation of arbitration, the Parties shall select the arbitrators. Novo, on the one hand, shall select [* * *] arbitrator and Dicerna, on the other hand, shall select [* * *] arbitrator (or, if either Party fails to make a choice, the ICC shall select [* * *] arbitrator on behalf of such Party) and the [* * *] arbitrators selected by the Parties will mutually select a [* * *] arbitrator (or, if they fail to make a choice, the ICC shall select a [* * *] arbitrator). In making their determination, the arbitrators shall not have the authority to modify any term or provision of this Agreement. A consensus decision of any [* * *] of the arbitrators shall be final, conclusive and binding on the Parties. The place of arbitration shall be v, and all proceedings and communications shall be in English.

10.5.3 Prior to the arbitrators being selected, either Party, without waiving any remedy under this Agreement, may seek from any court having jurisdiction any temporary injunctive or provisional relief necessary to protect the rights or property of that Party until final resolution of the issue by the arbitrators or other resolution of the controversy between the Parties. Once the

arbitrators are in place, either Party may apply to the arbitrators for interim injunctive relief until the arbitration award is rendered or the controversy is otherwise resolved, and either Party may apply to a court of competent jurisdiction to enforce interim injunctive relief granted by the arbitrators. Any final award by the arbitrators may be entered by either Party in any court having appropriate jurisdiction for a judicial recognition of the decision and applicable orders of enforcement. The arbitrators may render early or summary disposition of some or all issues, after the Parties have had a reasonable opportunity to make submissions on those issues. The arbitrators shall have no authority to award punitive or any other type of damages not measured by a Party's compensatory damages. The arbitrators may award the costs and expenses of the arbitration, including reasonable attorneys' fees, disbursements, arbitration expenses, arbitrators' fees and the administrative fee of the ICC, to the prevailing Party, which award shall be in such manner as the arbitrators deem appropriate, based on the determination of the arbitrators on the merits.

10.5.4 Except to the extent necessary to confirm an award or as may be required by law, neither a Party nor an arbitrator may disclose the existence, content, or results of an arbitration without the prior written consent of both Parties. In no event shall an arbitration be initiated after the date when commencement of a legal or equitable proceeding based on the dispute, controversy or claim would be barred by the applicable [* * *] statute of limitations.

10.5.5 As used in this Section 19.6, the term "**Excluded Claim**" means any dispute, controversy or claim that concerns: (a) the validity, enforceability or infringement of any patent, trademark or copyright; or (b) any antitrust, anti-monopoly or competition law or regulation, whether or not statutory. Any Excluded Claim may be submitted by either Party to any court of competent jurisdiction over such Excluded Claim.

10.6 Continued Performance During Pendency of Arbitral Matters. Unless and until this Agreement has terminated in accordance with its terms, the Parties shall continue to proceed with and be bound by all rights and obligations hereunder notwithstanding the issue of a Notice of Dispute or the pendency of an Arbitral Matter, litigation involving a patent issue pursuant to this Agreement, or any applicable Cure Period.

10.7 Consent to Non-Exclusive Jurisdiction; Service of Process. As may be permitted under this Agreement, any legal action or proceeding that may be brought, in a [* * *] and, by execution and delivery of this Agreement, each Party hereby consents for itself and in respect of its property, generally and unconditionally, to the non-exclusive jurisdiction of such courts. The Parties irrevocably waive any objection, including any objection to the laying of venue or based on the grounds of forum *non conveniens*, which either Party may now or hereafter have to the bringing of any such action of proceeding in such respective courts. Each Party irrevocably consents to the service of process of any such courts in any such action or proceeding by the mailing of copies thereof by registered or certified mail, postage prepaid, to the other Party at its address provided herein, such service to become effective [* * *] after such mailing.

10.8 Force Majeure. Neither Party shall be responsible to the other for any failure or delay in performing any of its obligations under this Agreement or for other nonperformance hereunder (excluding, in each case, the obligation to make payments when due) if such delay or nonperformance is caused by strike, fire, flood, earthquake, accident, war, act of terrorism, act of

God or of the government of any country or of any local government, or by any other cause unavoidable or beyond the control of any Party hereto. In such event, such affected Party shall use Commercially Reasonable Efforts to resume performance of its obligations and will keep the other Party informed of actions related thereto.

10.9 Waivers and Amendments. The failure of any Party to assert a right hereunder or to insist upon compliance with any term or condition of this Agreement shall not constitute a waiver of that right or excuse a similar subsequent failure to perform any such term or condition by the other Party. No waiver shall be effective unless it has been given in writing and signed by the Party giving such waiver. No provision of this Agreement may be amended or modified other than by a written document signed by authorized representatives of each Party.

10.10 Relationship of the Parties. Nothing contained in this Agreement shall be deemed to constitute a partnership, joint venture, or legal entity of any type between Dicerna and Novo, or to constitute one as the agent of the other. Each Party shall act solely as an independent contractor, and nothing in this Agreement shall be construed to give any Party the power or authority to act for, bind, or commit the other to any contract, agreement or undertaking with any third Party.

10.11 Notices. All notices, consents or waivers under this Agreement shall be in writing and will be deemed to have been duly given when: (a) scanned and converted into a portable document format file (*i.e.*, pdf file), and sent as an attachment to an e-mail message, where, when such message is received, a read receipt e-mail is received by the sender (and such read receipt e-mail is preserved by the Party sending the notice), provided further that a copy is promptly sent by an internationally recognized overnight delivery service (receipt requested) (although the sending of the e-mail message shall be when the notice is deemed to have been given); or (b) the earlier of when received by the addressee or [* * *] after it was sent, if sent by registered letter or overnight courier by an internationally recognized overnight delivery service (receipt requested), in each case to the appropriate addresses and e-mail addresses set forth below (or to such other addresses and e-mail addresses as a Party may designate by notice):

If to Dicerna:

Dicerna Pharmaceuticals, Inc.
33 Hayden Avenue

Lexington, Massachusetts 02421

Attention: President and Chief Executive Officer

Fax: [* * *]

E-mail: [* * *]

and

Dicerna Pharmaceuticals, Inc.

33 Hayden Avenue

Lexington, Massachusetts 02421

Attention: Legal Department

If to Novo:

Novo Nordisk A/S
Novo Alle 1
2880 Bagsvaerd
Denmark
Attention: CVP of Global Business Development

with a copy (which shall not constitute notice) to:

Novo Nordisk A/S
Novo Alle 1
2880 Bagsvaerd
Denmark
Attention: General Counsel

Dicerna shall also provide a copy of any notice (*via* e-mail if available) to Novo.

10.12 **Further Assurances**. Novo and Dicerna hereby covenant and agree without the necessity of any further consideration, to execute, acknowledge and deliver any and all documents and take any action as may be reasonably necessary to carry out the intent and purposes of this Agreement.

10.13 **Compliance with Law**. Each Party shall, or shall cause, its Affiliates, sublicensees or Third Party contractors to, perform its obligations under this Agreement in accordance with all Applicable Laws, including any GCPs, GLPs, GMPs or GRPs and Internal Compliance Codes, as applicable. No Party shall, or shall be required to, undertake any activity under or in connection

with this Agreement which violates, or which it believes, in good faith, may violate, any Applicable Laws.

10.14 No Third Party Beneficiary Rights. This Agreement is not intended to and shall not be construed to give any Third Party any interest or rights (including any Third Party beneficiary rights) with respect to or in connection with any agreement or provision contained herein or contemplated hereby, except as otherwise expressly provided for in this Agreement.

10.15 Entire Agreement. This Agreement sets forth the entire agreement and understanding of the Parties as to the subject matter hereof and supersedes all proposals, oral or written, and all other communications between the Parties with respect to such subject matter. The Parties acknowledge and agree that, as of the Effective Date, all Confidential Information disclosed pursuant to the Confidentiality Agreement by a Party or its Affiliates shall be included in the Confidential Information subject to this Agreement and the Confidentiality Agreement is hereby superseded in its entirety; provided, that the foregoing shall not relieve any Person of any right or obligation accruing under the Confidentiality Agreement prior to the Effective Date. "**Confidentiality Agreement**" means the Mutual Confidentiality Agreement between Dicerna and Novo dated August 14th, 2018, as amended on August 14, 2019, and further amended with respect to exclusivity disclosure on October 9, 2019.

10.16 Counterparts. This Agreement may be executed in two (2) or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument. Counterpart signature pages may be validly delivered by facsimile or by electronic mail in PDF format and such signature pages shall have the same effect as originals.

10.17 Expenses. Each Party shall pay its own costs, charges and expenses incurred in connection with the negotiation, preparation and execution of this Agreement.

10.18 Binding Effect. This Agreement shall be binding upon and inure to the benefit of the Parties and their respective legal representatives, successors and permitted assigns.

10.19 Construction. The Parties hereto acknowledge and agree that: (a) each Party and its counsel reviewed and negotiated the terms and provisions of this Agreement and have contributed to its revision; (b) the rule of construction to the effect that any ambiguities are resolved against the drafting Party shall not be employed in the interpretation of this Agreement; and (c) the terms and provisions of this Agreement shall be construed fairly as to all Parties hereto and not in a favor of or against any Party, regardless of which Party was generally responsible for the preparation of this Agreement.

10.20 Interpretation. The captions and headings to this Agreement are for convenience only, and are to be of no force or effect in construing or interpreting any of the provisions of this Agreement. Unless specified to the contrary, references to Articles, Sections, Schedules or Exhibits mean the particular Articles, Sections, Schedules or Exhibits to this Agreement and references to this Agreement include all Exhibits hereto. In the event of any conflict between the main body of this Agreement and any Exhibit hereto, the main body of this Agreement shall prevail. Unless context otherwise clearly requires, whenever used in this Agreement: (a) the words "include" or

"including" shall be construed as incorporating, also, "but not limited to" or "without limitation"; (b) the word "day" or "year" means a Calendar Day or year unless otherwise specified; (c) the word "notice" shall mean notice in writing (whether or not specifically stated) and shall include notices, consents, approvals and other written communications contemplated under this Agreement; (d) the words "hereof," "herein," "hereby" and derivative or similar words refer to this Agreement as a whole and not merely to the particular provision in which such words appear; (e) the words "shall" and "will" have interchangeable meanings for purposes of this Agreement; (f) provisions that require that a Party, the Parties or a committee hereunder "agree," "consent" or "approve" or the like shall require that such agreement, consent or approval be specific and in writing, whether by written agreement, letter, approved minutes or otherwise; (g) words of any gender include the other gender; (h) words using the singular or plural number also include the plural or singular number, respectively; (i) references to any specific law, rule or regulation, or article, section or other division thereof, shall be deemed to include the then-current amendments thereto or any replacement law, rule or regulation thereof; (j) the phrase "non-refundable" shall not prohibit, limit or restrict either Party's right to obtain damages in connection with a breach of this Agreement; and (k) neither Party shall be deemed to be acting on behalf of the other Party.

10.21 **Cumulative Remedies**. No remedy referred to in this Agreement is intended to be exclusive unless explicitly stated to be so, but each shall be cumulative and in addition to any other remedy referred to in this Agreement or otherwise available under law.

10.22 **Export**. Each Party acknowledges that the laws and regulations of the United States restrict the export and re-export of commodities and technical data of United States origin. Each Party agrees that it will not export or re-export restricted commodities or the technical data of the other Party in any form without appropriate United States and foreign government licenses.

[*Remainder of page left blank intentionally; signature page follows.*]

IN WITNESS WHEREOF, the Parties intending to be bound have caused this Agreement to be executed by their duly authorized representatives.

DICERNA PHARMACEUTICALS, INC.

By: /s/ Douglas Fambrough
Name: Douglas Fambrough
Title: CEO

NOVO NORDISK A/S

By: /s/ Karsten Munk Knudsen
Name: Karsten Munk Knudsen
Title: Executive Vice President

NOVO NORDISK A/S

By: /s/ Mads Krogsgaard Thomsen
Name: Mads Krogsgaard Thomsen
Title: Executive Vice President

Exhibit A

Work Flow Plan

[* * *]

Exhibit B

Initial Research Plan

To be attached hereto by the Parties as set forth in Section 4.1.4.

Exhibit C

Novo Nordisk A/S's Invoicing Instructions

In order to ensure timely settlement of invoices, you are kindly requested to observe the below guidelines when sending invoices or credit notes to Novo Nordisk.

All invoices should be sent *via* email by attaching the invoice as a PDF file, email address: [* * *]**.** Novo Nordisk is unable to process invoices sent by telefax.

All invoices must include the following information:

- **Full name and Novo Nordisk initials of the Project Director for Novo Nordisk**:
- It must be clearly stated that the document is an invoice

- A reference to the Novo Nordisk agreement ID _____

- Value Added Tax number or Federal ID/registration number

- Bank information:
  1. International Bank Account Number
  2. Bank Name: The name of beneficiary's bank
  3. Bank Address: The address of beneficiary's bank
  4. Bank Key #: ABA/Routing/Fedwire/Transit number/Sort Number
  5. Swift: Swift code
  6. Account Name: Under what name beneficiary's bank account is open
  7. Account Number: Number of beneficiary's bank account and/or IBAN code, which is applicable in all EU countries.

Exhibit D

Press Release

Dicerna and Novo Nordisk enter agreement to discover and develop RNAi therapies for liver-related cardio-metabolic diseases

- Collaboration to explore liver cell targets using Dicerna's GalXC™ technology with the potential to deliver a significant number of clinical candidates
- Each company to retain rights to co-develop and co-commercialise product candidates
- Dicerna to receive upfront payment of USD 175 million and equity investment of USD 50 million
- Dicerna is eligible to receive an additional USD 75 million over the first three years, plus up to USD 357.5 million per target in potential milestone payments, and royalties on product sales
- [* * *]

Lexington, Massachusetts, US, and Bagsværd, Denmark, 18 November 2019 – Dicerna™ Pharmaceuticals, Inc. (Nasdaq: DRNA) and Novo Nordisk A/S today announced an agreement to discover and develop novel therapies for the treatment of liver-related cardio-metabolic diseases using Dicerna's proprietary GalXC™ RNAi platform technology. The collaboration plans to explore more than 30 liver cell targets and may deliver multiple clinical candidates for disorders including chronic liver disease, non-alcoholic steatohepatitis (NASH), type 2 diabetes, obesity, and rare diseases. Dicerna will conduct and fund discovery and preclinical development to clinical candidate selection for each liver cell target, and Novo Nordisk will be responsible for all further development.

The agreement represents a significant investment by Novo Nordisk to secure access to Dicerna's proprietary GalXC RNAi platform, which complements its existing technology base. The collaboration provides Novo Nordisk with the capability to inhibit hepatocyte targets involved in disease regulation and has the potential to generate a number of clinical development candidates.

"We are excited to collaborate with Novo Nordisk on this broad research and development effort that extends the reach of our GalXC platform to a wide range of liver cell targets and maximises our opportunities in serious liver diseases," said Douglas M Fambrough, PhD, president and chief executive officer of Dicerna. "Our efforts will benefit from Novo Nordisk's expertise in cardio-metabolic diseases and years of experience developing and commercialising innovative therapies worldwide, which will help us advance novel RNAi treatments for underserved patient populations."

The agreement enables each company to co-develop and co-commercialise product candidates discovered under the collaboration. Novo Nordisk will lead programmes targeting cardio-metabolic disorders and other indications with Dicerna having the option to opt into two programmes during clinical development. Dicerna retains rights to initiate two new orphan liver disease programmes for which Novo Nordisk can opt in. For all co-development programmes,

the companies will share in the profit/loss of net sales of products consistent with each company's contribution to co-development costs.

"Through this important collaboration with Dicerna, we gain access to an innovative technology and deep expertise in RNA interference," said Marcus Schindler, senior vice president of Global Drug Discovery in Novo Nordisk. "Dicerna is the ideal partner to discover and develop molecules for targets that may yield multiple potential treatments across disease areas such as diabetes, obesity, cardiovascular and NASH. We will work closely together to unlock the true potential of treating a range of diseases using RNAi therapies, for the benefit of patients."

Under the terms of the agreement, Dicerna will receive:

- An upfront payment of USD 175 million.
- A USD 50 million equity investment in Dicerna at a premium.
- USD 25 million annually during each of the first three years of the collaboration, contingent on Dicerna delivering RNAi molecules for a defined number of targets.
- Up to USD 357.5 million per target in development, regulatory and commercialisation milestone payments, plus tiered royalties on product sales ranging from the mid-single-digits to mid-teens.

The transaction is subject to the expiration or termination of the waiting period under the Hart-Scott-Rodino Antitrust Improvements Act of 1976 and other customary conditions.

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About Dicerna's GalXC™ RNAi technology platform
Dicerna's proprietary RNA interference (RNAi) technology platform, called GalXC™, aims to advance the development of next-generation RNAi-based therapies designed to silence disease-driving genes in the liver and other tissues. Liver-targeted GalXC-based compounds enable subcutaneous delivery of RNAi therapies that are designed to bind specifically to receptors on liver cells, leading to internalisation and access to the RNAi machinery within the cells. The GalXC approach seeks to optimise the activity of the RNAi pathway so that it operates in the most specific and potent fashion. Compounds produced via GalXC are intended to be broadly applicable across multiple therapeutic areas, including both liver and non-liver indications.

About Dicerna™ Pharmaceuticals, Inc.
Dicerna™ Pharmaceuticals, Inc., is a biopharmaceutical company using ribonucleic acid (RNA) interference (RNAi) to develop medicines that silence genes that cause disease. The company is applying its proprietary GalXC™ technology to develop potent, selective, and safe RNAi therapies for treatment of rare diseases, chronic liver diseases, cardiovascular diseases, neurodegenerative diseases, pain and viral infectious disease. Dicerna aims to treat disease by addressing the underlying causes of illness with capabilities that extend beyond the liver to address a broad range of diseases, focusing on target genes where connections between gene and disease are well understood and documented. Dicerna intends to discover, develop and commercialise novel therapies either on its own or in collaboration with pharmaceutical partners. Dicerna has strategic collaborations with Novo Nordisk A/S, Roche, Eli Lilly and Company, Alexion Pharmaceuticals, Inc. and Boehringer Ingelheim International GmbH. For more information, please visit www.dicerna.com.

Dicerna Forward-Looking Statements
This press release includes forward-looking statements. Such forward-looking statements are subject to risks and uncertainties that could cause actual results to differ materially from those expressed or implied in such statements.

Examples of forward-looking statements include, among others, statements we make regarding: (i) the full potential to leverage our GalXC platform to target and silence specific genes that contribute to cardio-metabolic diseases; (ii) the potential to earn revenue from royalties and milestone payments under the collaboration with Novo Nordisk; (iii) research and development plans related to GalXC and its utility in silencing genes that contribute to cardio-metabolic diseases; (iv) the potential of RNAi therapies for the treatment of cardio-metabolic diseases; and (v) the potential for the collaboration and co-commercialization of products by Novo Nordisk and Dicerna. The process by which an early-stage platform such as GalXC could potentially lead to an approved product is long and subject to highly significant risks, particularly with respect to a preclinical research collaboration. Applicable risks and uncertainties include those relating to preclinical research and other risks identified under the heading "Risk Factors" included in Dicerna's most recent quarterly report on Form 10-Q and in other filings made by the company with the Securities and Exchange Commission. The forward-looking statements contained in this press release reflect Dicerna's current views with respect to future events, and Dicerna does not undertake and specifically disclaims any obligation to update any forward-looking statements, except as required by law.

* Novo Nordisk A/S and Roche transactions are subject to clearance under the Hart-Scott-Rodino Antitrust Improvements Act of 1976 and other customary closing conditions.

Dicerna™ and GalXC™ are trademarks of Dicerna Pharmaceuticals, Inc.

Novo Nordisk is a global healthcare company with more than 95 years of innovation and leadership in diabetes care. This heritage has given us experience and capabilities that also enable us to help people defeat obesity, haemophilia, growth disorders and other serious chronic diseases. Headquartered in Denmark, Novo Nordisk employs approximately 42,200 people in 80 countries and markets its products in more than 170 countries. For more information, visit novonordisk.com, Facebook, Twitter, LinkedIn, YouTube.

Further information

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Exhibit E

Existing Patents

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Exhibit F

Co-Development Programs Profit Sharing

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Exhibit G

Co-Promotion Principles

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Exhibit H

Dicerna Competitors

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Exhibit I

Dicerna Contract Manufacturers

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Exhibit J

Patent Prosecution: Default Countries & Territories

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Exhibit K

[Intentionally Omitted]

Exhibit L

Use of Human Biosamples and Informed Consent

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Exhibit M

NOVO Principles for the Use of Animals

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Exhibit 10.48

EXECUTION VERSION

SHARE ISSUANCE AGREEMENT

THIS SHARE ISSUANCE AGREEMENT (this "**Agreement**"), is made as of November 15, 2019, by and between Novo Nordisk A/S, a public limited liability company (the "**Share Acquiror**"), and Dicerna Pharmaceuticals, Inc., a Delaware corporation (the "**Company**").

WHEREAS, concurrently with the entering into of this Agreement, the Company and the Share Acquiror are entering into that certain Collaboration and License Agreement (the "**License Agreement**");

WHEREAS, pursuant to the terms and subject to the conditions set forth in this Agreement, the Company desires to issue and sell to the Share Acquiror, and the Share Acquiror desires to acquire from the Company, at the Closing (as defined below) 2,279,982 shares (the "**Shares**") of the Company's common stock, par value $0.0001 per share ("**Common Stock**"), for an aggregate purchase price of $50,000,005.26 (the "**Purchase Price**");

NOW, THEREFORE, in consideration of the foregoing recitals, the mutual representations, warranties, promises and obligations in the License Agreement and the following mutual representations, warranties, promises and obligations, and for other good and valuable consideration, the adequacy and sufficiency of which are hereby acknowledged, the Share Acquiror and the Company agree as follows:

1. Definitions.

1.1 Defined Terms. When used in this Agreement, the following terms shall have the respective meanings specified therefor below:

"**2014 ESPP**" means the 2014 Employee Stock Purchase Plan of the Company, as approved by the stockholders of the Company on January 28, 2014.

"**2014 Performance Incentive Plan**" means the 2014 Performance Incentive Plan of the Company, as adopted by the Board on January 14, 2014, as amended to date.

"**2016 Inducement Plan**" means the 2016 Inducement Plan of the Company, as adopted by the Board on March 4, 2016, as amended to date.

"**Affiliate**" means, with respect to a specified Person, any other Person that controls, is controlled by or is under common control with the applicable Person. As used herein, "controls", "control" and "controlled" means the possession, direct or indirect, of the power to direct the management and policies of a Person, whether through the ownership of voting interests of such Person, through Contract or otherwise; provided, that the Company and its Subsidiaries shall not be deemed Affiliates of the Share Acquiror or its Subsidiaries. Novo Holdings A/S, the Novo Nordisk Foundation, and Novozymes A/S and their respective Excluded Affiliates (other than Novo and its subsidiaries) are not considered Affiliates of Novo.

"**Agreement**" means as set forth in the Preamble, including all exhibits, schedules and appendices attached hereto.

"**Antitrust Law**" means any federal, state or foreign law, regulation or decree, including the HSR Act, designed to prohibit, restrict or regulate actions for the purpose or effect of monopolization or restraint of trade.

"**Beneficially Own**", "**Beneficially Owned**", "**Beneficial Ownership**" or "**Beneficial Owner**" and words of similar import have the meaning assigned to such terms pursuant to Rule 13d-3 under the Exchange Act.

"**Business Day**" means a day on which commercial banking institutions are open for business in each of Boston, Massachusetts, New York, New York and Copenhagen, Denmark .

"**Common Stock Equivalents**" means any options, warrants or other securities or rights convertible into or exercisable or exchangeable for, whether directly or following conversion into or exercise or exchange for other options, warrants or other securities or rights, shares of Common Stock.

"**Contract**" means, with respect to any Person, any written or oral contracts, agreements, deeds, mortgages, indentures, bonds, loans, leases, subleases, licenses, sublicense, statements of work, instruments, notes, commitments, commissions, undertakings, arrangements and understandings to which such Person is a party or by which any of its properties or assets are subject.

"**Disposition**" or "**Dispose of**" means (a) pledge, sale, contract to sell, sale of any option or Contract to purchase, purchase of any option or Contract to sell, grant of any option, right or warrant for the sale of, or other disposition of or transfer of any shares of Common Stock, or any Common Stock Equivalents, including, without limitation, any "short sale" or similar arrangement, or (b) swap, hedge, derivative instrument or any other agreement or any transaction that transfers, in whole or in part, directly or indirectly, the economic consequence of ownership of shares of Common Stock, whether any such swap or transaction is to be settled by delivery of securities, in cash or otherwise.

"**Exchange Act**" means the Securities Exchange Act of 1934, as amended.

"**Excluded Affiliates**" means with respect to Novo Holdings A/S, the Novo Nordisk Foundation, and Novozymes A/S and any person, corporation, company, partnership, joint venture or other entity, which Controls, is Controlled by, or is under common Control with such entities.

"**Governmental Authority**" means any applicable government authority, court, tribunal, arbitrator, agency, department, legislative body, commission or other instrumentality of (a) any government of any country or territory, (b) any nation, state, province, county, city or other political subdivision thereof or (c) any supranational body.

"**HSR Act**" means the Hart-Scott-Rodino Antitrust Improvements Act of 1976, as amended, and the rules and regulations promulgated thereunder.

"**Law**" or "**Laws**" means all laws, statutes, rules, regulations, orders, judgments, injunctions and/or ordinances of any Governmental Authority.

"**Material Adverse Effect**" shall mean any change, event or occurrence (each, an "**Effect**") that, individually or when taken together with all other effects that have occurred prior to the date of determination of the occurrence of the Material Adverse Effect, is or is reasonably likely to be materially adverse to the business, financial condition, assets, liabilities or results of operations of the Company and its Subsidiaries, taken as a whole; provided, however, that in no event shall any of the following occurring after the date hereof, alone or in combination, be deemed to constitute, or be taken into account in determining whether a Material Adverse Effect has occurred: (a) changes in the Company's industry generally or in conditions in the United States or global economy or capital or financial markets generally, including changes in interest or exchange rates, (b) any Effect caused by the announcement or pendency of the Transactions, or the identity of the Share Acquiror or any of its Affiliates as the purchaser in connection with the transactions contemplated by this Agreement or as a participant in the License Agreement, (c) the performance of this Agreement, the License Agreement and the transactions contemplated hereby and thereby, including compliance with the covenants set forth herein and therein, or any action taken or omitted to be taken by the Company at the request or with the prior consent of the Share Acquiror, (d) changes in general legal, regulatory, political, economic or business conditions occurring after the date hereof that, in each case, generally affect the biotechnology or biopharmaceutical industries, (e) acts of war, sabotage or terrorism occurring after the date hereof, or any escalation or worsening of any such acts of war, sabotage or terrorism, or (f) earthquakes, hurricanes, floods or other natural disasters occurring after the date hereof; provided, however, that with respect to clauses (a), (d), (e) and (f), such effects, alone or in combination, may be deemed to constitute, or be taken into account in determining whether a Material Adverse Effect has occurred, but only to the extent such effects disproportionately affect the Company and its Subsidiaries compared to other participants in the biotechnology or biopharmaceutical industries.

"**Material Contract**" means all Contracts that are required to be filed as exhibits by the Company with the SEC pursuant to Items 601(b)(4) and 601(b)(10) of Regulation S-K promulgated by the SEC.

"**Nasdaq**" means the Nasdaq Capital Market, the Nasdaq Global Market, or the Nasdaq Global Select Market.

"**Organizational Documents**" means (a) the Amended and Restated Certificate of Incorporation of the Company, as amended and restated from time to time and as in effect as of the date of this Agreement, and (b) the Amended and Restated Bylaws of the Company as in effect as of the date of this Agreement.

"**Permitted Transferee**" means an Affiliate of the Share Acquiror; provided, however, that no such Person shall be deemed a Permitted Transferee for any purpose under this Agreement unless: (a) the

Permitted Transferee, prior to or simultaneously with any Disposition, shall have agreed in writing to be subject to and bound by all restrictions and obligations set forth in this Agreement as though it were the Share Acquiror hereunder, and (b) the Share Acquiror acknowledges that it continues to be bound by all restrictions and obligations set forth in this Agreement.

"**Person**" means any individual, partnership, limited liability company, firm, corporation, trust, unincorporated organization, government or any department or agency thereof or other entity.

"**Prospectus**" means the prospectus (including any preliminary, final or summary prospectus) included in any Registration Statement, all amendments and supplements to such prospectus and all other material incorporated by reference in such prospectus

"**Register**," "**Registered**" and "**Registration**" means a registration effected by preparing and filing (a) a Registration Statement in compliance with the Securities Act (and any post-effective amendments filed or required to be filed) and the declaration or ordering of effectiveness of such Registration Statement, or (b) a Prospectus and/or Prospectus supplement in respect of an appropriate effective Registration Statement.

"**Registrable Securities**" means the Shares; provided, that any Shares will cease to be Registrable Securities when such Shares (A) have been sold or otherwise Disposed of pursuant to an effective Registration Statement or (B) may be sold under Rule 144 without regard to volume restrictions.

"**Registration Statement**" means a registration statement of the Company that covers the resale of any Registrable Securities pursuant to the provisions of Appendix 1 filed with, or to be filed with, the SEC under the rules and regulations promulgated under the Securities Act, including the related Prospectus, amendments and supplements to each such registration statement or Prospectus, including pre- and post-effective amendments, all exhibits thereto, financial information and all other material incorporated by reference or deemed to be incorporated by reference in such registration statement.

"**Rule 144"** means Rule 144 under the Securities Act.

"**Securities Act**" means the Securities Act of 1933, as amended.

"**Shelf Registration Statement**" means a "shelf" registration statement of the Company that covers all Registrable Securities on Form S-3 and under Rule 415 under the Securities Act or, if the Company is not then eligible to file on Form S-3, on another eligible form under the Securities Act, or any successor rule that may be adopted by the SEC, including without limitation any such registration statement filed pursuant to Appendix 1 and all amendments and supplements to such "shelf" registration statement, including, post-effective amendments, in each case, including the Prospectus contained therein, all exhibits thereto and any document incorporated by reference therein.

"**Subsidiary**" means any corporation, association trust, limited liability company, partnership, joint venture or other business association or entity (a) at least 50% of the outstanding voting securities of which are at the time owned or controlled directly or indirectly by the Company or (b) with respect to which the Company possesses, directly or indirectly, the power to direct or cause the direction of the affairs or management of such Person.

"**Tax**" or "**Taxes**" shall mean all federal, state, local, and foreign income, excise, gross receipts, gross income, ad valorem, profits, gains, property, capital, sales, transfer, use, payroll, employment, severance, withholding, duties, intangibles, franchise, backup withholding, value-added, and other taxes imposed by a Governmental Authority, together with all interest, penalties and additions to tax imposed with respect thereto.

"**Tax Return**" shall mean a report, return or other document (including any amendments thereto) required to be supplied to a Governmental Authority with respect to Taxes.

"**Third Party**" means any Person other than the Share Acquiror, the Company, or any Affiliate of the Share Acquiror or the Company.

"**Trading Market**" means the following markets or exchanges on which the Common Stock is listed or quoted for trading on the date in question: the Nasdaq Capital Market, the Nasdaq Global Market, the Nasdaq Global Select Market, the New York Stock Exchange or the NYSE MKT.

"**Transactions**" means the issuance of the Shares by the Company, and the acquisition of the Shares by the Share Acquiror, in accordance with the terms hereof, and any other transactions contemplated by this Agreement.

"**Transaction Agreements**" means this Agreement and the License Agreement.

"**Transfer Agent**" means American Stock Transfer & Trust Company, LLC, and any successor transfer agent of the Company.

"**Underwriter**" means, with respect any Underwritten Offering, a securities dealer who purchases any Registrable Securities as a principal in connection with a distribution of such Registrable Securities.

"**Underwritten Offering**" means a public offering of securities Registered under the Securities Act in which an Underwriter participates in the distribution of such securities, including on a firm commitment basis for reoffer and resale to the public, including any such offering that is a "bought deal" or a block trade.

1.2 Additional Defined Terms. In addition to the terms defined in Section 1.1, the following terms shall have the respective meanings assigned thereto in the sections indicated below:

Defined Term	Section
Board	Section 4.4(c)
Code	Section 4.16(b)
Closing	Section 3.1
Closing Date	Section 3.1
Common Stock	Recitals
Company	Preamble
Company SEC Reports	Section 4.9(a)
Enforceability Exceptions	Section 4.4(b)
FCPA	Section 4.20
FDA	Section 4.24
Financial Statements	Section 4.9(b)
GAAP	Section 4.9(b)
License Agreement	Recitals
Lockup Period	Section 6.3
Lockup Shares	Section 6.3
Money Laundering Laws	Section 4.21
OFAC	Section 4.22
Preferred Stock	Section 4.2(a)
Purchase Price	Recitals
Regulatory Authorities	Section 4.23
Regulatory Permits	Section 4.24
Required Approvals	Section 4.6
SEC	Section 4.6
Share Acquiror	Preamble
Shares	Recitals
Studies	Section 4.23
Third Party Tender/Exchange Offer	Section 6.3

2. Purchase and Sale of Common Stock. Subject to the terms and conditions of this Agreement, at the Closing, the Company shall issue and sell to the Share Acquiror and the Share Acquiror shall acquire from the Company the Shares for the Purchase Price, which shall be paid in cash; provided, however, that in the event of any stock dividend, stock split, combination of shares or recapitalization with respect to Common Stock after the date of this Agreement and on or prior to the Closing Date, the number of Shares shall be adjusted proportionately.

3. Closing Date; Deliveries.

3.1 Closing Date. The closing of the acquisition and issuance of the Shares hereunder (the "**Closing**") shall be held by electronic exchange of signature pages and Shares at 10:00 am (New York City time), on such date as is agreed to by the Company and the Share Acquiror, which date shall be no later

than the fifth (5th) Business Day after the satisfaction or waiver of the conditions to the Closing set forth in Sections 7 and 8 (other than those conditions that by their nature are to be satisfied at the Closing, but subject to the satisfaction or waiver of such conditions at the Closing), or at such other time and date as the parties may mutually agree in writing. The date the Closing occurs is hereinafter referred to as the "**Closing Date**."

3.2 Deliveries. (a) At the Closing, the Company shall deliver or cause to be delivered to the Share Acquiror (i) the Shares in book-entry form; (ii) evidence reasonably satisfactory to the Share Acquiror that the Shares have been issued to the Share Acquiror pursuant to a private placement exempt from registration under the Securities Act; (iii) a certificate, executed by the Chief Executive Officer or Chief Financial Officer of the Company, dated as of the Closing Date, to the effect that the Conditions specified in Section 8.1 and Section 8.2 have been satisfied; and (iv) a copy of the irrevocable instructions to the Transfer Agent instructing the Transfer Agent to deliver, on an expedited basis, the Shares to the Share Acquiror, via a book entry position in an account registered in the name of the Purchaser at the Transfer Agent and evidence of Share Acquiror's ownership of the Shares from the Transfer Agent in the form of Direct Registration Book Entry Advice; and (b) at least three (3) Business Days prior to the Closing Date, the Share Acquiror shall deliver to the Company the Purchase Price by wire transfer of immediately available funds to an account designated by the Company in writing to the Share Acquiror. The Company shall utilize an escrow agent reasonably acceptable to the Share Acquiror (it being understood that the Company's U.S. counsel Goodwin Procter LLP shall be reasonably acceptable for such purpose) to receive the Purchase Price as contemplated herein. The Company shall cause such escrow agent to follow the written instructions, including through means of electronic mail, of the Share Acquiror (or any one of its authorized representatives or that of its counsel) with respect to the release of the Purchase Price at the Closing. The Company and the Share Acquiror agree that no interest shall accrue on the Purchase Price deposited into the Company's account as contemplated by this Section 3.2.

4. Representations and Warranties of the Company. The Company hereby represents and warrants to the Share Acquiror as of the date hereof and as of the Closing Date as follows:

4.1 Organization. The Company is a corporation duly organized, validly existing and in good standing under the laws of the State of Delaware. The Company has all requisite corporate power and authority to enter into this Agreement, to issue the Shares and to perform its obligations under and to carry out the Transactions contemplated by this Agreement. The Company is duly qualified as a foreign corporation to transact business and is in good standing in each jurisdiction in which such qualification is required, whether by reason of the ownership or leasing of property or the conduct of business, except whether the failure to so qualify or be in good standing would not, individually or in the aggregate, constitute a Material Adverse Effect. The Company is not in violation of, in conflict with, or in default under its Organizational Documents in any material respect. True and correct copies of the Organizational Documents, as in effect on the date of this Agreement, are each filed or incorporated by reference as exhibits to the Company SEC Reports.

4.2 Capitalization.

(a) As of September 30, 2019, the authorized capital stock of the Company consists of (i) 150,000,000 shares of Common Stock and (ii) 5,000,000 shares of preferred stock, par value $0.0001 per share ("**Preferred Stock**"). As of September 30, 2019, (A) 68,360,051 shares of Common Stock are issued and outstanding; (B) no shares of Common Stock are held in the treasury of the Company; (C) no shares of Preferred Stock are issued or outstanding; (D) an aggregate of 4,522,599 shares of Common Stock are reserved for future issuance under the Company's 2014 Performance Incentive Plan, 2014 ESPP and 2016 Inducement Plan; (E) 12,801,016 shares of Common Stock are subject to outstanding options to acquire shares of Common Stock; (F) no shares of unvested restricted Common Stock are outstanding; and (G) 2,198 shares of Common Stock underlie outstanding warrants to purchase shares of Common Stock. Except as set forth in a written notice provided by the Company to the Share Acquiror prior to the execution of this Agreement and referencing this Section 4.2, as of the date of this Agreement, the Company has no other shares of capital stock or securities convertible into capital stock of the Company, authorized, issued or outstanding.

(b) All of the issued and outstanding shares of capital stock of the Company are duly authorized, validly issued, fully paid and non-assessable and have been issued in compliance with all federal and state securities Laws.

(c) Except as set forth in the Company SEC Reports and pursuant to this Agreement, no Person is entitled to preemptive rights with respect to any securities of the Company.

(d) The Company has no obligation (contingent or otherwise) to purchase, redeem or otherwise acquire any of its equity securities or any interests therein or to pay any dividend or make any distribution in respect thereof.

(e) Except as set forth in the Company SEC Reports and as may be provided in this Agreement, there are no voting agreements, buy-sell agreements or right of first purchase agreements among the Company and any of the stockholders of the Company relating to the securities of the Company held by them.

(f) The issuance and sale of the Shares hereunder will not obligate the Company to issue shares of Common Stock or other securities to any other Person (other than the Share Acquiror).

(g) The Company does not have outstanding any stockholder rights plans or "poison pill" or any similar arrangement in effect giving any Person the right to purchase any equity interest in the Company upon the occurrence of certain events.

4.3 Subsidiaries. A complete list of each direct and indirect Subsidiary of the Company, including its name and jurisdiction of incorporation or formation, is attached hereto as Exhibit A. Each Subsidiary has been duly incorporated or organized, as the case may be, and is validly existing as a

corporation, partnership or limited liability company, as applicable, in good standing under the laws of the jurisdiction of its incorporation or organization and has the power and authority (corporate or other) to own, lease and operate its properties and to conduct its business as presently conducted. Each Subsidiary is duly qualified as a foreign corporation, partnership or limited liability company, as applicable, to transact business and is in good standing in each jurisdiction in which such qualification is required, whether by reason of the ownership or leasing of property or the conduct of business, except where the failure to so qualify or be in good standing would not, individually or in the aggregate, constitute a Material Adverse Effect. All of the issued and outstanding capital stock or other equity or ownership interests of each Subsidiary have been duly authorized and validly issued, are fully paid and nonassessable and are owned by the Company, directly or through subsidiaries, free and clear of any encumbrances or preemptive and similar rights to subscribe for or purchase securities.

4.4 Authorization.

(a) All requisite corporate action on the part of the Company required by applicable Law for the authorization, execution and delivery by the Company of this Agreement and the performance of all obligations of the Company hereunder and thereunder, including the authorization, issuance and delivery of the Shares, has been taken.

(b) This Agreement has been duly executed and delivered by the Company, and upon the due execution and delivery of this Agreement by the Share Acquiror, it will constitute valid and legally binding obligations of the Company, enforceable against the Company in accordance with its terms, except as limited by: (i) applicable bankruptcy, insolvency, reorganization, moratorium, fraudulent conveyance and other Laws of general application relating to or affecting enforcement of creditors' rights generally; and (ii) as limited by Laws relating to the availability of specific performance, injunctive relief or other equitable remedies (the exceptions set forth in (i) and (ii), the "**Enforceability Exceptions**").

(c) On or prior to the date hereof, the Board of Directors of the Company (the "**Board**") has duly adopted resolutions, among other things, authorizing and approving each of the Transaction Agreements and the Transactions.

4.5 No Conflicts. Except as set forth in a written notice provided by the Company to the Share Acquiror prior to the execution of this Agreement and referencing this Section 4.5, the execution, delivery and performance of this Agreement, and compliance with the provisions hereof, and the issuance of the Shares by the Company do not and shall not: (a) subject to receipt of the Required Approvals, violate any provision of applicable Law or any ruling, writ, injunction, order, permit, judgment or decree of any Governmental Authority to which the Company is subject, (b) result in any encumbrance upon any of the Shares, other than restrictions on resale pursuant to securities laws or as set forth in this Agreement, (c) result in a default, modification, acceleration of payment or termination under, give any Person a right of termination or cancellation under, result in the loss of a benefit or imposition of any obligation under, any Material Contract, or (d) violate or conflict with any of the provisions of the Organizational Documents,

except, in the case of subsections (a) and (c) as would not, individually or in the aggregate, constitute a Material Adverse Effect.

4.6 No Approval. No consent, approval, authorization or other order of, or filing with, or notice to, any Governmental Authority is required to be obtained or made by the Company or any of its Subsidiaries in connection with the authorization, execution and delivery by the Company of this Agreement or with the authorization, issuance and sale by the Company of the Shares, or the consummation of the Transactions, except (a) such filings as may be required to be made with the Securities and Exchange Commission (the "**SEC**") and with any state blue sky or securities regulatory authority, which filings shall be made in a timely manner in accordance with all applicable Laws; (b) as required pursuant to the HSR Act; and (c) those that have been made or obtained prior to the date of this Agreement (the items referred to in clauses (a) and (c), the "**Required Approvals**").

4.7 Valid Issuance of Shares. When issued, sold and delivered at the Closing in accordance with the terms hereof, the Shares will be duly authorized, validly issued, fully paid and nonassessable, free from any liens, encumbrances or restrictions on transfer, including preemptive rights, rights of first refusal, purchase option, call option, subscription right or other similar rights, other than as arising pursuant to this Agreement, as a result of any action by the Share Acquiror or under federal or state securities Laws. Assuming the accuracy of the representations and warranties of the Share Acquiror in this Agreement and subject to the Required Approvals, the Shares will be issued in compliance with all applicable federal and state securities Laws. No stop order or suspension of trading of Common Stock has been imposed by Nasdaq or the SEC and remains in effect.

4.8 Nasdaq Listing. The Common Stock is listed on Nasdaq and registered pursuant to Section 12(b) of the Exchange Act, and the Company has taken no action (a) designed to terminate or reasonably likely to cause the termination of the registration of the Common Stock under the Exchange Act and the Company has not received any written notification that the SEC is contemplating terminating such registration or (b) designed to delist or reasonably likely to cause the delisting of the Common Stock from Nasdaq. There are no proceedings pending or, to the knowledge of the Company, threatened to revoke or suspend the Company's listing on Nasdaq or the listing of the Shares. The Company is in compliance in all material respects with the requirements of Nasdaq for continued listing of Common Stock thereon.

4.9 Company SEC Reports.

(a) The Company has timely filed or furnished, as applicable, all reports, schedules, forms, statements and other documents required to be filed or furnished by it with the SEC since January 1, 2019, pursuant to the reporting requirements of the Exchange Act (all of the foregoing filed prior to the date of this Agreement and all exhibits included therein and financial statements and schedules thereto and documents (other than exhibits) incorporated by reference therein, collectively, the "**Company SEC Reports**"), each of which complied at the time of filing in all material respects with all applicable requirements of the Securities Act and the Exchange Act, as applicable, in each case as in effect on the

dates such forms reports and documents were filed. As of its respective date, and if amended, as of the date of the last such amendment, no Company SEC Report, since January 1, 2019, when filed, contained any untrue statement of a material fact or omitted to state a material fact required to be stated therein or necessary in order to make the statements therein, in light of the circumstances under which they were made, not misleading. All Material Contracts to which the Company or any Subsidiary is a party, or to which the property or assets of the Company or any Subsidiary are subject, that are required to be included as part of or specifically identified in the Company SEC Reports, are so included or specifically identified. True and complete copies of the Company SEC Reports are available for public access via the SEC's EDGAR system.

(b) As of their respective dates, the consolidated financial statements included or incorporated in the Company SEC Reports (the "**Financial Statements**"), and the related notes, complied as to form in all material respects with applicable accounting requirements and the published rules and regulations of the SEC with respect thereto. The Financial Statements and the related notes have been prepared in accordance with accounting principles generally accepted in the United States ("**GAAP**"), consistently applied, during the periods involved (except (i) as may be otherwise indicated in the Financial Statements or the notes thereto, or (ii) in the case of unaudited interim statements, to the extent they may not include footnotes, may be condensed or summary statements or may conform to the SEC's rules and instructions for Quarterly Reports on Form 10-Q) and fairly present in all material respects the consolidated financial position and the results of the operations of the Company and its Subsidiaries, retained earnings (loss), and cash flows, as the case may be, for the periods then ended (subject, in the case of unaudited statements, to normal and recurring year-end audit adjustments).

(c) The Company has established and maintains disclosure controls and procedures (as defined in Rules 13a-15 and 15d-15 under the Exchange Act) that (i) are designed to ensure that material information relating to the Company, including each consolidated Subsidiary, is made known to the Company's principal executive officer and its principal financial officer by others within those entities, particularly during the periods in which the periodic reports required under the Exchange Act are being prepared; (ii) have been evaluated by management of the Company for effectiveness as of the end of the Company's most recent fiscal quarter; and (iii) are effective in all material respects to perform the functions for which they were established. Since the end of the Company's most recent audited fiscal year, there have been no significant deficiencies or material weaknesses in the Company's internal control over financial reporting (whether or not remediated) and no change in the Company's internal control over financial reporting that has materially affected, or is reasonably likely to materially affect, the Company's internal control over financial reporting.

4.10 No Undisclosed Material Liabilities. The Company does not have any liabilities or obligations of any nature (whether accrued, absolute, contingent or otherwise) required to be reflected or reserved against on a consolidated balance sheet of the Company prepared in accordance with GAAP or the notes thereto, except for liabilities or obligations (a) reflected or reserved against on the most recent

consolidated balance sheet of the Company included in the Company SEC Reports or the notes thereto, or (b) incurred since the date of such balance sheet in the ordinary course of business.

4.11 Material Contracts. Except as set forth in a written notice provided by the Company to the Share Acquiror prior to the execution of this Agreement and referencing this Section 4.11, each Material Contract of the Company is in the Company SEC Reports. Each Material Contract is the legal, valid and binding obligations of the Company, enforceable against the Company in accordance with their respective terms, and, to the knowledge of the Company, are valid and binding obligations of the other party thereto, enforceable against each other party thereto in accordance with its terms, except as limited by the Enforceability Exceptions. There has not occurred any breach, violation or default or any event that, with the lapse of time, the giving of notice or the election of any Person, or any combination thereof, would constitute a breach, violation or default by the Company under any such Material Contract or, to the knowledge of the Company, by any other Person to any such Material Contract. The Company has not been notified that any Third Party to any Material Contract intends to cancel, terminate, not renew or exercise an option under any Material Contract, whether in connection with the Transactions or otherwise.

4.12 Voting Rights. Other than as provided by this Agreement or any Contract or other document listed as an exhibit to a Company SEC Report, there are no provisions in the Organizational Documents or any Contract to which the Company or any Subsidiary is a party that (a) would reasonably be expected to affect or restrict the voting rights of the Share Acquiror with respect to the Shares in its capacity as a stockholder of the Company, (b) would reasonably be expected to adversely affect the Company's or the Share Acquiror's right or ability to consummate the Transactions or comply with the terms of this Agreement, (c) require the vote of more than a majority of the Company's issued and outstanding Common Stock to take or prevent any corporate action, other than those matters requiring a different vote under Delaware law or (d) entitle any party to nominate or elect any director of the Company or require any of the Company's stockholders to vote for any such nominee or other Person as a director of the Company.

4.13 No Integrated Offering. Neither the Company, nor any of its Affiliates or any other Person acting on the Company's behalf, has directly or indirectly engaged in any form of general solicitation or general advertising with respect to the Shares nor have any of such Persons made any offers or sales of any security of the Company or its Affiliates or solicited any offers to buy any security of the Company or its Affiliates under circumstances that would require registration of the Shares under the Securities Act or cause this offering of Shares to be integrated with any prior offering of securities of the Company for purposes of the Securities Act or any applicable shareholder approval provisions of any Trading Market on which any of the securities of the Company are listed or designated, nor will the Company take any action or steps that would cause the offering or issuance of the Shares to be integrated with other offerings.

4.14 Offering; Exemption. Assuming the accuracy of the Share Acquiror's representations and warranties set forth in Section 5, no registration under the Securities Act or any applicable state securities

law is required for the offer and sale of the Shares by the Company to the Share Acquiror as contemplated hereby.

4.15 Legal Proceedings and Liabilities. Neither the Company nor any of its Subsidiaries is a party to any, and there are no pending, or to the knowledge of the Company, threatened, material legal, administrative, arbitral or other proceedings, claims, actions or governmental investigations of any nature against the Company or any of its Subsidiaries. Neither the Company nor any of its Subsidiaries is subject to any order, judgment or decree of a Governmental Authority. To the knowledge of the Company, there is no material investigation pending or threatened by any Governmental Authority with respect to the Company or any of its Subsidiaries.

4.16 Taxes and Tax Returns.

(a) The Company and each of its Subsidiaries has timely filed (taking into account all applicable extensions) all Tax Returns with respect to income taxes and all other material Tax Returns required to be filed by it, and all such Tax Returns were correct and complete in all material respects, and the Company and each of its Subsidiaries has paid (or has had paid on its behalf) to the appropriate Governmental Authority all material Taxes that are required to be paid by it, except, in each case, with respect to matters contested in good faith and for which adequate reserves have been established in accordance with GAAP. There are no disputes pending, or claims asserted in writing, in respect of Taxes of the Company or any of its Subsidiaries for which reserves that are adequate under GAAP have not been established.

(b) The Company has not been a United States real property holding company within the meaning of Section 897(c)(2) of the Internal Revenue Code of 1986, as amended (the "**Code**") during the period specified in Section 897(c)(1)(A)(ii) of the Code.

4.17 Intellectual Property Matters. Except as otherwise disclosed in the Company SEC Reports, the Company and its subsidiaries own, or have obtained valid and enforceable licenses for, the inventions, patent applications, patents, trademarks, trade names, service names, copyrights, trade secrets and other intellectual property described in the Company SEC Reports as being owned or licensed by them or which are necessary for the conduct of their respective businesses as currently conducted or as currently proposed to be conducted (collectively, "Intellectual Property"). Except as otherwise disclosed in the Company SEC Reports, to the Company's knowledge: (i) there are no third parties who have rights to any Intellectual Property, except for customary reversionary rights of third-party licensors with respect to Intellectual Property that is disclosed in the Company SEC Reports as exclusively licensed to the Company or one or more of its subsidiaries; and (ii) there is no infringement by third parties of any Intellectual Property. Except as otherwise disclosed in the Company SEC Reports, there is no pending or, to the Company's knowledge, threatened action, suit, proceeding or claim by others: (A) challenging the Company's rights in or to any Intellectual Property, and the Company is unaware of any facts which would form a reasonable basis for any such action, suit, proceeding or claim; (B) challenging the validity,

enforceability or scope of any Intellectual Property, and the Company is unaware of any facts which would form a reasonable basis for any such action, suit, proceeding or claim; or (C) asserting that the Company or any of its subsidiaries infringes or otherwise violates, or would, upon the commercialization of any product or service described in the Company SEC Reports as under development, infringe or violate, any patent, trademark, trade name, service name, copyright, trade secret or other proprietary rights of others, and the Company is unaware of any facts which would form a reasonable basis for any such action, suit, proceeding or claim.

4.18 Absence of Changes. Since December 31, 2018, except as set forth in subsequent Company SEC Reports, there has not been:

(a) any declaration, setting aside or payment of any dividend or other distribution with respect to any shares of capital stock of the Company or any repurchase, redemption or other acquisition by the Company of any outstanding shares of its capital stock;

(b) any material Tax election made or changed, any audit settled or any amended Tax Returns filed;

(c) any damage, destruction or loss (whether or not covered by insurance) that has had or would reasonably be expected to have a Material Adverse Effect;

(d) any sale, assignment or transfer, or any Contract to sell, assign or transfer, any material asset, liability, property, obligation or right of the Company or any Subsidiary to any Person, including, without limitation, the Share Acquiror and its Affiliates, in each case, other than in the ordinary course of business;

(e) any material obligation or liability incurred, or any material loans or advances made, by the Company or any Subsidiary to any of its or their Affiliates, other than expenses allowable in the ordinary course of business of the Company;

(f) any purchase or acquisition of, or Contract, plan or arrangement to purchase or acquire, any material property, rights or assets other than in the ordinary course of business of the Company;

(g) any material waiver of any material rights or claims of the Company or any Subsidiary;

(h) any material lien upon, or adversely affecting, any material property or other material assets of the Company or any Subsidiary;

(i) any Contract or commitment by the Company or any Subsidiary to do any of the foregoing; or

(j) any other change, development, occurrence or event that has had or would reasonably be expected to have a Material Adverse Effect.

4.19 Compliance with Laws. Since January 1, 2019, except as set forth in subsequent Company SEC Reports, (a) the Company and its Subsidiaries have complied in all material respects with all applicable Laws and (b) to the knowledge of the Company, neither the Company nor any of its Subsidiaries has been investigated with respect to, or has been threatened in writing to be charged with, or given notice of any violation in any material respect of, any applicable Law.

4.20 Foreign Corrupt Practices Act. Neither the Company nor any of its Subsidiaries nor, to the knowledge of the Company, any director, officer, agent, employee or other Person acting on behalf of the Company or any of its Subsidiaries has, in the course of its actions for, or on behalf of, the Company or any of its Subsidiaries (a) used any corporate funds for any unlawful contribution, gift, entertainment or other unlawful expenses relating to political activity; (b) made any direct or indirect unlawful payment to any domestic government official, "foreign official" (as defined in the U.S. Foreign Corrupt Practices Act of 1977, as amended, and the rules and regulations thereunder (collectively, the "**FCPA**")) or employee from corporate funds; (c) violated or is in violation of any provision of the FCPA or, to the knowledge of the Company, any applicable non-U.S. anti-bribery statute or regulation; or (d) made any unlawful bribe, rebate, payoff, influence payment, kickback or other unlawful payment to any domestic government official, such foreign official or employee. The Company and its Subsidiaries have conducted their respective businesses in compliance with the FCPA and have instituted and maintain policies and procedures designed to ensure, and that are reasonably expected to continue to ensure, continued compliance therewith.

4.21 Money Laundering Laws. The operations of the Company and its Subsidiaries are, and have been conducted at all times, in compliance with applicable financial recordkeeping and reporting requirements of the Currency and Foreign Transactions Reporting Act of 1970, as amended, and to the knowledge of the Company, the money laundering statutes of all applicable jurisdictions, the rules and regulations thereunder and any related or similar applicable rules, regulations or guidelines, issued, administered or enforced by any Governmental Authority (collectively, the "**Money Laundering Laws**").

4.22 OFAC. Neither the Company nor any of its Subsidiaries nor, to the knowledge of the Company, any director, officer, agent, employee or Person acting on behalf of the Company or any of its Subsidiaries is currently subject to any U.S. sanctions administered by the Office of Foreign Assets Control of the U.S. Treasury Department ("**OFAC**"); and the Company will not directly or indirectly use the proceeds from the sale of the Shares, or lend, contribute or otherwise make available such proceeds to any Subsidiary or any joint venture partner or other Person, for the purpose of financing the activities of or business with any Person, or in any country or territory, that currently is subject to any U.S. sanctions administered by OFAC or in any other manner that will result in a violation by any Person (including any Person participating in the transaction whether as Underwriter, advisor, investor or otherwise) of U.S. sanctions administered by OFAC.

4.23 Preclinical and Clinical Data and Regulatory Compliance. The preclinical tests and clinical trials (collectively, "**Studies**") that are described in, or the results of which are referred to in, the Company SEC Reports were and, if still pending, are being conducted in all material respects in accordance with the protocols, procedures and controls designed and approved for such Studies. Except as set forth in the Company SEC Reports, neither the Company nor any Subsidiary has received any written notice of, or correspondence from, any Regulatory Authority or institutional review board requiring the termination, suspension or material modification of any Studies that are described or referred to in the Company SEC Reports and the Company and each Subsidiary have operated and currently are in compliance in all material respects with applicable Laws, rules, regulations and policies of the federal, state, local or foreign agencies or bodies engaged in the regulation of pharmaceuticals and biological products such as those being developed by the Company (collectively, "**Regulatory Authorities**"), including current Good Laboratory Practices and current Good Clinical Practices.

4.24 Regulatory Permits. Except as set forth in the Company SEC Reports, (a) the Company and each Subsidiary have such material permits, licenses, certificates, approvals, clearances, authorizations or amendments thereto (the "**Regulatory Permits**") issued by the appropriate federal, state, local or foreign regulatory agencies or bodies necessary to conduct the business of the Company as currently conducted and as described in the Company SEC Reports, including, without limitation, any Investigational New Drug Application as required by the United States Food and Drug Administration ("**FDA**") or authorizations issued by Regulatory Authorities; (b) the Company and each Subsidiary are in compliance in all material respects with the requirements of the Regulatory Permits, and all of the Regulatory Permits are valid and in full force and effect, in each case in all material respects; (c) the Company has not received any notice of proceedings relating to the revocation, termination, modification or impairment of any of the Regulatory Permits; (d) neither the Company nor any Subsidiary has failed to file with the FDA or any other Regulatory Authority any material required application, submission, report, document, notice, supplement or amendment, and all such filings were in material compliance with applicable Laws when filed and have been supplemented as necessary to remain in material compliance with applicable Laws and no material deficiencies have been asserted by the FDA or any other Regulatory Authority with respect to any such filings.

4.25 Related-Party Transactions. Except as set forth in the Company SEC Reports, there are no business relationships or related-party transactions involving the Company or any Subsidiary or any other Person of the type required to be disclosed in the Company SEC Reports pursuant to Item 404 of Regulation S-K promulgated by the SEC.

4.26 Brokers' or Finders' Fees. No broker, finder, investment banker or other Person is entitled to any brokerage, finder's or other fee or commission from the Company in connection with the Transactions.

4.27 Not Investment Company. The Company is not, and immediately after the consummation of the Transactions, will not be, an "investment company" as defined in the Investment Company Act of 1940, as amended.

4.28 No Registration Rights. Except as set forth in the Company's SEC Documents or in a written notice provided by the Company to the Share Acquiror prior to the execution of this Agreement and referencing this Section 4.28, (a) no Person has the right to (i) prohibit the Company from filing a Registration Statement or (ii) require the Company to register any securities for sale under the Securities Act by reason of the filing of a Registration Statement, except in the case of clause (ii) for rights which have been properly satisfied or waived; and (b) the granting and performance of the registration rights under this Agreement will not violate or conflict with, or result in a breach of any provision of, or constitute a default under, any Contract to which the Company is a party.

4.29 Certain Employee Matters. No officer or employee of the Company, to the knowledge of the Company, is, or is now expected to be, in material violation of any material term of any employment contract, confidentiality, disclosure or proprietary information agreement or non-competition agreement, or any other Contract or any restrictive covenant, and the continued employment of each such officer or employee does not subject the Company or any Subsidiary to any material liability with respect to any of the foregoing matters, except as would not reasonably be expected to result in a Material Adverse Effect.

5. Representations and Warranties of the Share Acquiror. The Share Acquiror hereby represents and warrants to the Company as of the date hereof and as of the Closing Date as follows:

5.1 Organization. The Share Acquiror is a public limited liability company duly organized, validly existing and in good standing under the laws of Denmark. The Share Acquiror has all requisite power and authority to enter into this Agreement, to purchase the Shares and to perform its obligations under and to carry out the Transactions.

5.2 Authorization. All requisite corporate or other comparable action on the part of the Share Acquiror, required by applicable Law for the authorization, execution and delivery by the Share Acquiror of this Agreement and the performance of all of its obligations hereunder, including the acquisition of the Shares, has been taken. This Agreement has been duly executed and delivered by the Share Acquiror, and upon the due execution and delivery thereof by the Company, will constitute valid and legally binding obligations of the Share Acquiror, enforceable against the Share Acquiror in accordance with its terms, except as limited by the Enforceability Exceptions.

5.3 No Conflicts. The execution, delivery and performance of this Agreement and compliance with the provisions thereof, by the Share Acquiror do not and shall not: (a) violate any provision of applicable Law or any ruling, writ, injunction, order, permit, judgment or decree of any Governmental Authority, or (b) violate or conflict with any of the provisions of the Share Acquiror's organizational documents (including any articles or memoranda of organization or association, charter, by-laws or similar

documents), except as would not materially impair or affect in a material adverse manner the ability of the Share Acquiror to consummate the Transactions and perform its obligations under this Agreement.

5.4 No Approval. No consent, approval, authorization or other order of any Governmental Authority is required to be obtained by the Share Acquiror in connection with the authorization, execution and delivery of any of this Agreement or with the subscription for and purchase of the Shares, except as required pursuant to the HSR Act.

5.5 Acquisition Entirely for Own Account. The Shares shall be acquired for investment for the Share Acquiror's own account, not as a nominee or agent, and not with a view to the resale or distribution of any part thereof, and the Share Acquiror has no present intention of selling, granting any participation or otherwise distributing the Shares. The Share Acquiror does not have and will not have as of the Closing any Contract, undertaking or arrangement with any Person to sell, transfer or grant participation to a Person any of the Shares.

5.6 Investment Experience and Accredited Investor Status. The Share Acquiror is an "accredited investor" (as defined in Regulation D under the Securities Act). The Share Acquiror has conducted its own due diligence on the Company to its satisfaction and has such knowledge and experience in financial or business matters that it is capable of evaluating the merits and risks of the investment in the Shares to be purchased hereunder. The Share Acquiror acknowledges and understands that its investment in the Shares involves a significant degree of risk. The Share Acquiror is able to bear the economic risk of holding the Shares for an indefinite period. The Share Acquiror has, in connection with the Share Acquiror's decision to subscribe for the Shares, not relied upon any representations, warranties or other information (whether oral or written) of or related to the Company other than: (i) those representations and warranties of the Company specifically set forth herein and (ii) the information contained in the Company SEC Reports. The Share Acquiror understands that nothing in this Agreement or any other materials presented by or on behalf of the Company to the Share Acquiror in connection with the purchase of the Shares constitutes legal, tax or investment advice. The Share Acquiror has consulted such legal, tax and investment advisors as it, in its sole discretion, has deemed necessary or appropriate in connection with its purchase of the Shares.

5.7 Restricted Securities. The Share Acquiror understands that the Shares, when issued, will be "restricted securities" under the federal securities laws inasmuch as they are being acquired from the Company in a transaction not involving a public offering and that under such Laws the Shares may be resold without registration under the Securities Act only in certain limited circumstances. The Share Acquiror represents that it is familiar with Rule 144.

5.8 Legends. In addition to any other legend required by Law, the book-entry or certificated form of the Shares shall bear any legend required by the "blue sky" laws of any state and a restrictive legend in substantially the following form:

THESE SECURITIES HAVE NOT BEEN REGISTERED UNDER THE SECURITIES ACT OF 1933, AS AMENDED. THEY MAY NOT BE SOLD, OFFERED FOR SALE, PLEDGED OR HYPOTHECATED IN THE ABSENCE OF A REGISTRATION STATEMENT IN EFFECT WITH RESPECT TO THE SECURITIES UNDER SUCH ACT OR AN OPINION OF COUNSEL SATISFACTORY TO THE ISSUER THAT SUCH REGISTRATION IS NOT REQUIRED OR UNLESS SOLD PURSUANT TO RULE 144 OF SUCH ACT.

5.9 Acquiring Person. As of the date of this Agreement and immediately prior to the Closing, neither the Share Acquiror nor any of its controlled Affiliates (excluding directors and officers of the Share Acquiror who may hold securities of the Company for their personal account) Beneficially Owns, or will Beneficially Own any securities of the Company.

5.10 United States Person. If the Share Acquiror is not a United States person (as defined by Section 7701(a)(30) of the Internal Revenue Code), the Share Acquiror hereby represents that it has satisfied itself as to the full observance of the laws of its jurisdiction in connection with any invitation to subscribe for the Shares or any use of this Agreement, including (i) the legal requirements within its jurisdiction for the purchase of the Shares, (ii) any foreign exchange restrictions applicable to such purchase, (iii) any governmental or other consents that may need to be obtained, and (iv) the income tax and other tax consequences, if any, that may be relevant to the purchase, holding, redemption, sale, or transfer of the Shares. The Share Acquiror's subscription and payment for and continued beneficial ownership of the Shares will not violate any applicable securities or other laws of the Share Acquiror's jurisdiction.

5.11 No General Solicitation. The Share Acquiror is not acquiring the Shares as a result of (a) any advertisement, article, notice or other communication published in any newspaper, magazine or similar media or broadcast over television, radio or the Internet, in each case, relating to the Company, or (ii) any seminar or meeting whose attendees, including the Share Acquiror, have been invited by any general solicitation or general advertising related to the Company.

5.12 Information. The Share Acquiror has had the opportunity to review the Company SEC Reports. The Share Acquiror has been afforded the opportunity to ask questions of the Company regarding the Company, including without limitation, all aspects of the Company's business, operations, financial condition, prospects, intellectual property and pending disputes. The Share Acquiror further acknowledges that it has had the opportunity to ask such questions as it has deemed necessary of, and to receive answers from, representatives of the Company concerning the terms and conditions of the offering of the Securities and the merits and risks of investing in the Securities. Neither such inquiries nor any other investigation conducted by or on behalf of the Share Acquiror or its representatives or counsel shall modify, amend or affect the Share Acquiror's right to rely on the truth, accuracy and completeness of the Company SEC Reports and the Company's representations and warranties contained in this Agreement, it being agreed that the Company has made and does not make any representations or warranties to the Share Acquiror except as expressly set forth herein. The Share Acquiror understands that no United States federal or state agency or any other government or governmental agency has passed upon or made any recommendation

or endorsement of the Shares or the fairness or suitability of the investment in the Shares nor have such authorities passed upon or endorsed the merits of the offering of the Shares.

5.13 No Short Sales. Between the time the Share Acquiror learned about the Transactions and the public announcement of thereof, neither the Share Acquiror nor any Affiliate of the Share Acquiror which (x) had knowledge of the Transactions, (y) has or shares discretion relating to the Share Acquiror's investments or trading or information concerning the Share Acquiror's investments, including in respect of the Shares, and (z) is subject to the Share Acquiror's review or input concerning such Affiliate's investments or trading, has effected or agreed to effect any purchases or sales of the Company's Common Stock or engaged in any short sales or similar transactions with respect to the Company's Common Stock or any derivative thereof, nor has the Share Acquiror, directly or indirectly, caused any Person to engage in any short sales or similar transactions with respect to the Company's Common Stock or any derivative thereof, including, without limitation, and in each case, in any transaction aimed, directly or indirectly, at affecting the price of the Company's Common Stock for purposes of the transactions contemplated by this Agreement.

6. Covenants.

6.1 Reasonable Best Efforts. Subject to the terms and conditions set forth in this Agreement, each party hereto shall use its reasonable best efforts to do or cause to be done all things necessary or appropriate to satisfy the conditions to the Closing and to consummate the Transactions as promptly as practicable. Without limiting the generality of the foregoing, unless the License Agreement is earlier terminated by either party in accordance with its terms, the Company and the Share Acquiror shall use their respective reasonable best efforts to cause the Closing to occur. Each of the Company and the Share Acquiror shall not, and shall not permit any of their respective Affiliates to, take any action that would, or that would reasonably be expected to, result in any of the conditions set forth in Section 7 or Section 8 not being satisfied.

6.2 Notification under the HSR Act. The parties shall make, or cause to be made, the filings required of them under the HSR Act in connection with the Transactions and shall take related actions as provided in the License Agreement.

6.3 Lock-Up. During the period commencing on the Closing Date and until the date that is nine (9) months after the Closing Date (the "**Lockup Period**"), without the prior approval of the Company, the Share Acquiror shall not Dispose of (x) any of the Shares, together with any shares of Common Stock issued in respect thereof as a result of any stock split, stock dividend, share exchange, merger, consolidation or similar recapitalization, and (y) any Common Stock issued as (or issuable upon the exercise of any warrant, right or other security that is issued as) a dividend or other distribution with respect to, or in exchange or in replacement of, the shares of Common Stock described in clause (x) of this sentence (collectively, "**Lockup Shares**"); provided, however, that the foregoing shall not prohibit (a) the Share Acquiror from transferring any Lockup Shares to (i) a Permitted Transferee (provided, that the Permitted

Transferee agrees to be bound in writing by the restrictions set forth herein), or (ii) to the Company; (b) the Disposition of Lockup Shares with the prior written consent of the Company; and (c) the Disposition of Lockup Shares pursuant to a Third Party Tender/Exchange Offer, as defined below, and any Disposition effected pursuant to any merger, consolidation or similar transaction consummated by the Company. "**Third Party Tender/Exchange Offer**" means any tender or exchange offer made to all of the holders of shares of Common Stock by a Third Party (other than a Third Party acting on behalf of or as part of a group or in concert with the Share Acquiror) solely to the extent that the Board has recommended such tender or exchange offer in a Schedule 14D-9 under the Exchange Act. For the avoidance of doubt, nothing in this Section 6.3 will restrict any Disposition of shares of Common Stock held by an executive officer or director of the Share Acquiror for his or her personal account.

6.4 Registration Rights. In the event the Shares as of the Closing Date equal or exceed 10% of the Company's outstanding Common Stock, the Company hereby provides the Share Acquiror with the registration rights set forth on Appendix 1 attached hereto, which is hereby incorporated in and made a part of this Agreement as if set forth in full herein.

6.5 Participation Rights. If the Share Acquiror agrees to enter into a customary confidentiality agreement with the Company, for so long as the Share Acquiror holds one hundred percent (100%) of the Shares and such Shares equal or exceed at least five percent (5%) of the Company's outstanding shares of Common Stock, the Company will use its commercially reasonable efforts to allow the Share Acquiror to participate (pro rata with its percentage ownership of the outstanding Common Stock) in public offerings and private placements of its Common Stock to financial, non-strategic investors primarily for capital raising purposes, subject to any limitations (a) imposed by the Company's underwriters or investment bankers or (b) arising under securities or other applicable Laws; provided, that in no event will this Section 6.5 be deemed to provide the Share Acquiror with any rights (i) to membership on, or observation of, the Board or any other special information rights or (ii) with respect to "at the market" or "ATM" offerings.

6.6 Facilitation of Sales Pursuant to Rule 144. For as long as the Share Acquiror or its Affiliates Beneficially Owns any Shares, to the extent it shall be required to do so under the Exchange Act, the Company shall use reasonable best efforts to timely file the reports required to be filed by it under the Exchange Act or the Securities Act (including the reports under Sections 13 and 15(d) of the Exchange Act referred to in subparagraph (c)(1) of Rule 144), and, following expiration of the Lock-Up Period, shall use reasonable best efforts to take such further necessary action as the Share Acquiror may reasonably request in connection with the removal of any restrictive legend, including the legend set forth in Section 5.8 of this Agreement, on the Shares (i) following any sale of such Shares pursuant to Rule 144 or (ii) if such Shares are eligible for sale under Rule 144 without regard to volume or manner-of-sale restrictions under Rule 144, all to the extent required from time to time to enable such holder to sell the Shares without registration under the Securities Act within the limitations of the exemption provided by Rule 144. The Company agrees that at such time as any legend set forth in Section 5.8 is no longer required under this Section 6.5, the Company will, no later than two (2) Business Days following receipt from the Share

Acquiror by the Company and the Transfer Agent of customary representations and other documentation reasonably acceptable to the Company and the Transfer Agent remove any such legend in the Company's stock records. Notwithstanding the foregoing, the Company shall not have any obligations pursuant to this Section 6.5 during any time when a Registration Statement covering the Shares is effective.

6.7 Press Release. The parties have mutually approved a press release with respect to this Agreement and either party may make subsequent public disclosure of the content of such press release. Subject to the foregoing, each party agrees not to issue any press release or other public statement, whether oral or written, disclosing the terms hereof without the prior written consent of the other party; provided, however, that neither party will be prevented from complying with any duty of disclosure it may have pursuant to applicable Laws or pursuant to the rules of any recognized stock exchange or quotation system.

6.8 Blue Sky. The Company shall take such action as the Company shall reasonably determine is necessary in order to obtain an exemption, or to qualify the Shares, for sale to the Share Acquiror at the Closing under the applicable securities or "Blue Sky" laws of the Commonwealth of Massachusetts, and shall provide evidence of such actions promptly upon request of the Share Acquiror.

7. Conditions to the Company's Obligations. The obligations of the Company under Section 2 hereof are subject to the fulfillment prior to or on the Closing Date of all of the following conditions, any of which may be waived in whole or in part by the Company.

7.1 Representations and Warranties. The representations and warranties of the Share Acquiror contained in this Agreement and in any certificate, if any, or other writing, if any, delivered by the Share Acquiror pursuant hereto shall be true and correct in all material respects on and as of the Closing Date, except those representations and warranties qualified by materiality or Material Adverse Effect, which representations and warranties shall be true and correct in all respects, with the same effect as though such representations and warranties had been made on and as of the Closing Date (except to the extent expressly made as of an earlier date, in which case as of such earlier date).

7.2 Performance. The Share Acquiror shall have performed and complied in all material respects with all agreements, obligations and conditions contained in this Agreement that are required to be performed or complied with it on or before the Closing.

7.3 HSR Act Qualification. The filings required under the HSR Act in connection with this Agreement shall have been made and the required waiting period shall have expired or been terminated as of the Closing Date.

7.4 License Agreement. Each of the Company and the Share Acquiror shall have executed and delivered the License Agreement, and the License Agreement shall not have been terminated and shall be effective in accordance with its terms.

8. Conditions to the Share Acquiror's Obligations. The obligations of the Share Acquiror under Section 2 hereof are subject to the fulfillment prior to or on the Closing Date of all of the following conditions, any of which may be waived in whole or in part by the Share Acquiror.

8.1 Representations and Warranties. The representations and warranties of the Company contained in this Agreement and in any certificate, if any, or other writing, if any, delivered by the Company pursuant hereto shall be true and correct in all material respects on and as of the Closing Date, except those representations and warranties qualified by materiality or Material Adverse Effect, which representations and warranties shall be true and correct in all respects, with the same effect as though such representations and warranties had been made on and as of the Closing Date (except to the extent expressly made as of an earlier date, in which case as of such earlier date).

8.2 Performance. The Company shall have performed and complied in all material respects with all agreements, obligations and conditions contained in this Agreement that are required to be performed or complied with it on or before the Closing.

8.3 HSR Act Qualification. The filings required under the HSR Act in connection with this Agreement shall have been made and the required waiting period shall have expired or been terminated as of the Closing Date.

8.4 License Agreement. Each of the Company and the Share Acquiror shall have executed and delivered the License Agreement, and the License Agreement shall not have been terminated and shall be effective in accordance with its terms.

8.5 No Stockholder Approval Required; Consents. No approval on the part of the stockholders of the Company shall be required in connection with the execution and delivery by the Company of this Agreement and the consummation of the Transactions. All consents necessary or appropriate for the consummation of the transactions contemplated by this Agreement shall have been obtained.

8.6 Qualification Under State Securities Laws. All registrations, qualifications, permits and approvals, if any, required to be obtained prior to the Closing under applicable state securities laws shall have been obtained for the lawful execution, delivery and performance of this Agreement or the other Transaction Agreements, including, without limitation, the offer and sale of the Shares.

8.7 Nasdaq Matters.

(a) Prior to the Closing, the Company shall have taken all actions which are necessary, including providing appropriate notice to Nasdaq of the Transactions and the filing of a Notification Form: Listing of Additional Shares, for the Shares purchased at the Closing to remain listed on Nasdaq and shall have complied with all listing, reporting, filing and other obligations under the rules of Nasdaq and of the SEC.

(b) The Common Stock shall not have been suspended, as of the Closing Date, by the SEC or Nasdaq from trading on Nasdaq nor shall suspension by the SEC or Nasdaq have been threatened, as of the Closing Date, in writing by the SEC or Nasdaq.

8.8 Absence of Litigation. No proceeding challenging the Transaction Agreements or the Transactions, or seeking to prohibit, alter, prevent or materially delay the Closing, shall have been instituted by any Governmental Authority.

8.9 Company Deliverables. The Company shall have delivered or caused to be delivered to the Share Acquiror all of the items set forth in Section 3.2(a) of this Agreement.

9. Termination. This Agreement may only be terminated and shall automatically terminate if the License Agreement has been terminated prior to the Closing Date in accordance with its terms. In the event of the termination of this Agreement pursuant to this Section 9, (a) this Agreement (except for this Section 9) shall forthwith become void and have no effect, without any liability on the part of any party hereto or its Affiliates, and (b) all filings, applications and other submissions made pursuant to this Agreement, to the extent practicable, shall be withdrawn from the agency or other Person to which they were made or appropriately amended to reflect the termination of the Transactions; provided, however, that nothing contained in this Section 9 shall relieve any party from liability for fraud or any intentional or willful breach of this Agreement.

10. Survival. The representations and warranties contained in this Agreement shall survive the Closing of the Transactions until the date that is one (1) year following the date of this Agreement. The covenants and agreements contained in this Agreement shall survive Closing of the Transactions. The rights and remedies that may be exercised by the Share Acquiror shall not be limited or otherwise affected by or as a result of any information furnished to, or any investigation made by or knowledge of, the Share Acquiror or its representatives.

11. Miscellaneous.

11.1 Governing Law; Submission to Jurisdiction. This Agreement shall be governed by and construed in accordance with the Laws of the State of New York, without regard to the conflict of laws principles thereof that would require the application of the Law of any other jurisdiction. Any action brought, arising out of, or relating to this Agreement shall, if it has jurisdiction, be brought in the courts of the State of New York located in New York County or the United States District Court for the Southern District of New York. Each party hereby irrevocably submits to the exclusive jurisdiction of said Court in respect of any claim relating to the validity, interpretation and enforcement of this Agreement, and hereby waives, and agrees not to assert, as a defense in any action, suit or proceeding in which any such claim is made that it is not subject thereto or that such action, suit or proceeding may not be brought or is not maintainable in such courts, or that the venue thereof may not be appropriate or that this Agreement may not be enforced in or by such courts. The parties hereby consent to and grant the courts of the State of New York located

in New York County and the United States District Court for the Southern District of New York jurisdiction over such parties and over the subject matter of any such claim and agree that mailing of process or other papers in connection with any such action, suit or proceeding in the manner provided in Section 11.3 hereof or in such other manner as may be permitted by Law, shall be valid and sufficient thereof.

11.2 No Waiver, Modifications. It is agreed that no waiver by a party hereto of any breach or default of any of the covenants or agreements set forth herein shall be deemed a waiver as to any subsequent or similar breach or default. The failure of either party to insist on the performance of any obligation hereunder shall not be deemed a waiver of any such obligation. No amendment, modification, waiver, release or discharge to this Agreement shall be binding upon the parties unless in writing and duly executed by authorized representatives of both parties.

11.3 Notices. Any consent, notice, report or other communication required or permitted to be given or made under this Agreement by one of the parties to the other party will be delivered in writing by one of the following means and be effective: (a) upon receipt, if delivered personally; (b) when sent, if sent via e-mail (provided that such sent e-mail is kept on file (whether electronically or otherwise) by the sending party and the sending party does not immediately receive an automatically generated message from the recipient's e-mail server that such e-mail could not be delivered to such recipient); or (c) when delivered by a reputable, commercial overnight courier; provided in all cases addressed to such other party at its address indicated below, or to such other address as the addressee will have last furnished in writing to the addressor and will be effective upon receipt by the addressee.

If to Share Acquiror:

Novo Nordisk A/S
Novo Alle 1
2880 Bagsvaerd
Denmark
Attention: CVP of Global Business Development

with a copy (which shall not constitute notice) to:

Novo Nordisk A/S
Novo Alle 1
2880 Bagsvaerd
Denmark
Attention: General Counsel

If to the Company:

Dicerna Pharmaceuticals, Inc.
87 Cambridgepark Drive
Cambridge, MA 02140
Attention: Jack Green
Facsimile: 617-612-6298
e-mail: jgreen@dicerna.com

with a copy (which shall not constitute notice) to:

Goodwin Procter LLP
601 Marshall Street
Redwood City, California 94063
Attention: Sam Zucker
Facsimile: (650) 752-3100
e-mail: szucker@goodwinlaw.com

Written confirmation of receipt (i) given by the recipient of such notice or (ii) provided by an overnight courier service shall be rebuttable evidence of personal service, receipt by receipt from an overnight courier service in accordance with clause (a) or (c) above, respectively. A copy of the e-mail transmission containing the time, date and recipient e-mail address shall be rebuttable evidence of receipt by e-mail in accordance with clause (b) above.

11.4 Entire Agreement. This Agreement (including all exhibits, schedules and annexes attached hereto) and the License Agreement contain the entire agreement among the parties with respect to the subject matter hereof and thereof and supersede all prior and contemporaneous arrangements or understandings, whether written or oral, with respect hereto and thereto.

11.5 Headings; Nouns and Pronouns; Section References. Headings in this Agreement are for convenience of reference only and shall not be considered in construing this Agreement. Whenever the context may require, any pronouns used herein shall include the corresponding masculine, feminine or neuter forms, and the singular form of names and pronouns shall include the plural and vice-versa. References in this Agreement to a section or subsection shall be deemed to refer to a section or subsection of this Agreement unless otherwise expressly stated.

11.6 Severability. If any provision of this Agreement is held to be illegal, invalid or unenforceable under any present or future Law, (a) such provision shall be fully severable, (b) this Agreement shall be construed and enforced as if such illegal, invalid or unenforceable provision had never comprised a part hereof, (c) the remaining provisions of this Agreement shall remain in full force and effect and shall not be affected by the illegal, invalid or unenforceable provision or by its severance herefrom, and (d) in lieu of such illegal, invalid or unenforceable provision, the parties shall negotiate in good faith a substitute

legal, valid and enforceable provision as similar in terms to such illegal, invalid or unenforceable provision as possible and as reasonably acceptable to the parties.

11.7 Assignment. Except for an assignment by the Share Acquiror of this Agreement or any rights hereunder to an Affiliate or Permitted Transferee (which assignment will not relieve the Share Acquiror of any obligation hereunder), neither this Agreement nor any of the rights or obligations hereunder may be assigned by either the Share Acquiror or the Company without (a) the prior written consent of Company in the case of any assignment by the Share Acquiror or (b) the prior written consent of the Share Acquiror in the case of an assignment by the Company.

11.8 Successors and Assigns. This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors and permitted assigns.

11.9 Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original but which together shall constitute one and the same instrument. In the event that any signature is delivered by an e-mail which contains a portable document format (.pdf) file of an executed signature page, such executed signature page shall create a valid and binding obligation of the party executing it (or on whose behalf such signature page is executed) with the same force and effect as if such executed signature page were an original thereof.

11.10 Third Party Beneficiaries. None of the provisions of this Agreement shall be for the benefit of or enforceable by any Third Party, including any creditor of any party hereto, except that each Affiliate of the Share Acquiror is an express third party beneficiary entitled to enforce this Agreement directly against the Company. No Third Party shall obtain any right under any provision of this Agreement or shall by reason of any such provision make any claim in respect of any debt, liability or obligation (or otherwise) against any party hereto.

11.11 No Strict Construction. This Agreement has been prepared jointly and will not be construed against either party. No presumption as to construction of this Agreement shall apply against either party with respect to any ambiguity in the wording of any provision(s) of this Agreement irrespective of which party may be deemed to have authored the ambiguous provision(s).

11.12 Remedies. The rights, powers and remedies of the parties under this Agreement are cumulative and not exclusive of any other right, power or remedy which such parties may have under any other Contract or Law. No single or partial assertion or exercise of any right, power or remedy of a party hereunder shall preclude any other or further assertion or exercise thereof. The parties hereby acknowledge and agree that the rights of the parties hereunder are special, unique and of extraordinary character, and that if any party refuses or otherwise fails to act, or to cause its Affiliates to act, in accordance with the provisions of this Agreement, such refusal or failure would result in irreparable injury to the Company or the Share Acquiror as the case may be, the exact amount of which would be difficult to ascertain or estimate and the remedies at law for which would not be reasonable or adequate compensation. Accordingly, if any

party refuses or otherwise fails to act, or to cause its Affiliates to act, in accordance with the provisions of this Agreement, then, in addition to any other remedy which may be available to any damaged party at law or in equity, such damaged party will be entitled to seek specific performance and injunctive relief, without posting bond or other security, and without the necessity of proving actual or threatened damages, which remedy such damaged party will be entitled to seek in any court of competent jurisdiction.

11.13 Expenses. Each party shall pay its own fees and expenses in connection with the preparation, negotiation, execution, delivery and performance of the Transaction Agreements.

[*Signature Page Follows*]

IN WITNESS WHEREOF, the parties have executed and delivered this Agreement as of the date first above written.

Dicerna Pharmaceuticals, Inc., a Delaware corporation

By: /s/ Douglas M. Fambrough
Name: Douglas M. Fambrough, III. Ph.D.
Title: Chief Executive Officer

Novo Nordisk A/S, a public limited liability company

By: /s/ Karsten Munk Knudsen
Name: Karsten Munk Knudsen
Title: Executive Vice President

By: /s/ Mads Krogsgaard Thomsen
Name: Mads Krogsgaard Thomsen
Title: Executive Vice President

APPENDIX 1

REGISTRATION RIGHTS

1. Resale Registration.

1.1 On or prior to the first (1st) Business Day following the expiration of the Lockup Period, the Company will file a Shelf Registration Statement registering for resale the Registrable Securities under the Securities Act. The Company shall use its commercially reasonable efforts to cause such Shelf Registration Statement to become effective as promptly as practicable after filing. Until the earlier of such time as (i) all Registrable Securities cease to be Registrable Securities or (ii) the Company is no longer eligible to maintain a Shelf Registration Statement, the Company will keep current and effective such Shelf Registration Statement and file such supplements or amendments to such Shelf Registration Statement (or file a new Shelf Registration Statement when such preceding Shelf Registration Statement expires pursuant to the rules of the SEC) as may be necessary or appropriate in order to keep such Shelf Registration Statement continuously effective and useable for the resale of Registrable Securities under the Securities Act. The Shelf Registration Statement shall include the Plan of Distribution attached hereto as Annex A.

1.2 If the filing, initial effectiveness or continued use of the Shelf Registration Statement at any time would require the Company to make a public disclosure of material non-public information that the Company has a bona fide business purpose for not disclosing publicly at such time, the Company may, upon giving prompt written notice of such action to the Share Acquiror, delay the filing or initial effectiveness of, or suspend use of, the Shelf Registration Statement (a "**Suspension**"); provided, however, that the Company shall not be permitted to exercise a Suspension more than once during any twelve (12) month period for a period not to exceed sixty (60) days. In the case of a Suspension, the Share Acquiror agrees to suspend use of the applicable Prospectus in connection with any sale or purchase, or offer to sell or purchase, Shares, upon receipt of the notice referred to above. The Company shall immediately notify the Share Acquiror in writing upon the termination of any Suspension, amend or supplement the Prospectus, if necessary, so it does not contain any untrue statement or omission and furnish to the Share Acquiror such numbers of copies of the Prospectus as so amended or supplemented as the Share Acquiror may reasonably request. The Company shall, if necessary, supplement or amend the Shelf Registration Statement, if required by law or as may reasonably be requested by the Share Acquiror.

2. Information. The Company may require the Share Acquiror to furnish to the Company such information regarding the distribution of the Shares and such other information relating to the Share Acquiror and its ownership of Shares as the Company may from time to time reasonably request in writing to the extent that such information is required to be included in the Shelf Registration Statement.

3. Expenses. All expenses incident to the Company's performance of or compliance with this Agreement shall be paid by the Company, including (a) all registration and filing fees, and any other fees and expenses associated with filings required to be made with the SEC or Financial Industry Regulatory

Authority, (b) all fees and expenses in connection with compliance with any securities or "Blue Sky" laws (including reasonable fees and disbursements of counsel for the Underwriters in connection with blue sky qualifications of the Shares), (c) all printing, duplicating, word processing, messenger, telephone and delivery expenses (including expenses of printing certificates for the Shares in a form eligible for deposit with The Depository Trust Company and of printing Prospectuses), (d) all fees and disbursements of counsel for the Company and of all independent certified public accountants or independent auditors of the Company and any of its Subsidiaries (including the expenses of any special audit and comfort letters required by or incident to such performance), (e) Securities Act liability insurance or similar insurance if the Company so desires, (f) all fees and expenses incurred in connection with the listing of the Shares on any securities exchange or quotation of the Shares on any inter-dealer quotation system, (g) all fees and expenses of any special experts or other Persons retained by the Company in connection with any registration, and (h) all of the Company's internal expenses (including all salaries and expenses of its officers and employees performing legal or accounting duties). For the avoidance of doubt, the Company shall not be required to pay any underwriting discounts and commissions and transfer Taxes, if any, attributable to the sale of the Shares.

4. Notice. The Company shall notify the Share Acquiror immediately upon (a) any request by the SEC or any other Federal or state Governmental Authority for amendments or supplements to a Shelf Registration Statement or for additional information that pertains to the Share Acquiror as a selling stockholder; (b) the issuance by the SEC of any stop order suspending the effectiveness of the Shelf Registration Statement or any order by the SEC or any other regulatory authority preventing or suspending the use of any Prospectus or the initiation or threatening of any proceedings for such purposes, (c) receipt by the Company of any notification with respect to the suspension of the qualification of the Shares for offering or sale in any jurisdiction or the initiation or threatening of any proceeding for such purpose, or (d) the Company becoming aware that the Shelf Registration Statement or the related Prospectus contains any untrue statement of a material fact or omits to state a material fact necessary to make the statements therein (in the case of such Prospectus, in light of the circumstances under which they were made) not misleading.

5. Indemnification.

5.1 To the extent permitted by Law, the Company will indemnify and hold harmless the Share Acquiror, its officers and directors, and each Person who controls the Share Acquiror (within the meaning of the Securities Act or the Exchange Act), and the officers and directors, of each such controlling Person, from and against any and all losses, claims, liabilities, damages, deficiencies, assessments, fines, judgments, fees, costs (including, without limitation, reasonable costs of preparation and reasonable attorneys' fees) and expenses (collectively "**Losses**") (joint or several), as incurred, to which they may become subject under the Securities Act, the Exchange Act or other federal or state law, insofar as such Losses (or actions in respect thereof) arise out of, relate to, or are based upon any of the following statements, omissions or violations (collectively a "**Violation**") by the Company: (a) any untrue statement or alleged

untrue statement of a material fact contained in the Shelf Registration Statement or incorporated by reference therein, including any Prospectus contained therein or any amendments or supplements thereto, (b) the omission or alleged omission to state therein a material fact required to be stated therein, or necessary to make the statements therein not misleading, or (c) any violation or alleged violation by the Company of the Securities Act, the Exchange Act, any state securities Law, or any rule or regulation promulgated under the Securities Act, the Exchange Act or any state securities Law in connection with the Shelf Registration Statement; and the Company will reimburse each such indemnified party for any legal or other expenses reasonably incurred by them in connection with investigating or defending any such Loss or action if it is judicially determined that there was such a Share Acquiror Violation; provided however, that the indemnity agreement contained in this Section 5.1 will not apply to amounts paid in settlement of any such Loss or action if such settlement is effected without the Company's consent, nor will the Company be liable in any such case for any such Loss to the extent that it arises out of or is based upon a Violation which occurs in reliance upon and in conformity with written information furnished by the Share Acquiror and stated to be expressly for use in connection with the Shelf Registration Statement or an applicable Prospectus.

5.2 To the extent permitted by Law, the Share Acquiror will indemnify and hold harmless the Company and each of its directors and its officers against any Losses (joint or several) to which the Company or any such director, officer, controlling Person, Underwriter or other Third Party who may become subject under the Securities Act, the Exchange Act or other federal or state law, insofar as such Losses (or actions in respect thereto) arise out of or are based upon any of the following statements: (a) any untrue statement or alleged untrue statement of a material fact contained in any Registration Statement or any other document incorporated reference therein, including any preliminary Prospectus or final Prospectus contained therein or any amendments or supplements thereto, or (b) the omission or alleged omission to state therein a material fact required to be stated therein, or necessary to make the statements therein not misleading (collectively, a "**Share Acquiror Violation**"), in each case to the extent (and only to the extent) that such Share Acquiror Violation occurs in reliance upon and in conformity with written information furnished by the Share Acquiror under an instrument duly executed by the Share Acquiror; and the Share Acquiror will reimburse any legal or other expenses reasonably incurred by the Company or any such director, officer, controlling Person, Underwriter or other Third Party in connection with investigating or defending any such Loss or action if it is judicially determined that there was such a Share Acquiror Violation; provided, however, that the indemnity agreement contained in this Section 5.2 will not apply to amounts paid in settlement of any such Loss or action if such settlement is effected without the Share Acquiror's consent; provided, further that the obligations of the Share Acquiror hereunder shall be limited to an amount equal to the net proceeds it receives in such Registration.

5.3 Promptly after receipt by an indemnified party under this Section 5 of notice of the commencement of any action (including any governmental action), such indemnified party will, if a claim in respect thereof is to be made against any indemnifying party under this Section 5, deliver to the indemnifying party a written notice of the commencement thereof and the indemnifying party will have the right to participate in, and, to the extent the indemnifying party so desires, jointly with any other

indemnifying party similarly noticed, to assume the defense thereof with counsel mutually satisfactory to the parties; provided, however, that an indemnified party will have the right to retain its own counsel, with the fees and expenses thereof to be paid by the indemnifying party, if representation of such indemnified party by the counsel retained by the indemnifying party would be inappropriate due to actual or potential differing interests between such indemnified party and any other party represented by such counsel in such proceeding. The failure to deliver written notice to the indemnifying party within a reasonable time of the commencement of any such action will relieve such indemnifying party of any liability to the indemnified party under this Section 5 to the extent, and only to the extent, prejudicial to its ability to defend such action, but the omission so to deliver written notice to the indemnifying party will not relieve it of any liability that it may have to any indemnified party otherwise than under this Section 5.

5.4 If the indemnification provided for in this Section 5 is held by a court of competent jurisdiction to be unavailable to an indemnified party with respect to any Losses referred to herein, the indemnifying party, in lieu of indemnifying such indemnified party thereunder, will to the extent permitted by applicable Law contribute to the amount paid or payable by such indemnified party as a result of such Loss in such proportion as is appropriate to reflect the relative fault of the indemnifying party, on the one hand, and of the indemnified party, on the other, in connection with the Violation(s) or Share Acquiror Violation(s), as applicable, that resulted in such Loss, as well as any other relevant equitable considerations. The relative fault of the indemnifying party and of the indemnified party will be determined by a court of law by reference to, among other things, whether the untrue or alleged untrue statement of a material fact or the omission to state a material fact relates to information supplied by the indemnifying party or by the indemnified party and the parties' relative intent, knowledge, access to information and opportunity to correct or prevent such statement or omission; provided, however, that the obligations of the Share Acquiror hereunder shall be limited to an amount equal to the net proceeds it receives in such Registration; and provided, further, that no Person guilty of fraudulent misrepresentation within the meaning of Section 11(f) of the Securities Act) shall be entitled to contribution from any Person who was not guilty of such fraudulent misrepresentation.

5.5 The obligations of the Company and the Share Acquiror under this Section 5 will survive termination of this Agreement and the expiration or withdrawal of the Shelf Registration Statement. No indemnifying party, in the defense of any such claim or litigation, will, except with the consent of each indemnified party, consent to entry of any judgment or enter into any settlement which does not include as an unconditional term thereof the giving by the claimant or plaintiff to such indemnified party of a release from all liability in respect to such claim or litigation.

[*Remainder of page intentionally left blank*]

ANNEX A

PLAN OF DISTRIBUTION

The selling securityholders, including their pledgees, donees, transferees, distributees, beneficiaries or other successors in interest, may from time to time offer some or all of the shares of common stock (collectively, "**Securities**") covered by this prospectus. To the extent required, this prospectus may be amended and supplemented from time to time to describe a specific plan of distribution.

The selling securityholders will not pay any of the costs, expenses and fees in connection with the registration and sale of the Securities covered by this prospectus, but they will pay any and all underwriting discounts, selling commissions and stock transfer taxes, if any, attributable to sales of the Securities. We will not receive any proceeds from the sale of Securities.

The selling securityholders may sell the Securities covered by this prospectus from time to time, and may also decide not to sell all or any of the Securities that they are allowed to sell under this prospectus. The selling securityholders will act independently of us in making decisions regarding the timing, manner and size of each sale. These dispositions may be at fixed prices, at market prices prevailing at the time of sale, at prices related to such prevailing market prices, at varying prices determined at the time of sale, or at privately negotiated prices. Sales may be made by the selling securityholders in one or more types of transactions, which may include:

- purchases by underwriters, dealers and agents who may receive compensation in the form of underwriting discounts, concessions or commissions from the selling securityholders and/or the purchasers of the Securities for whom they may act as agent;

- one or more block transactions, including transactions in which the broker or dealer so engaged will attempt to sell the Securities as agent but may position and resell a portion of the block as principal to facilitate the transaction, or in crosses, in which the same broker acts as an agent on both sides of the trade;

- ordinary brokerage transactions or transactions in which a broker solicits purchases;

- purchases by a broker-dealer or market maker, as principal, and resale by the broker-dealer for its account;

- the pledge of Securities for any loan or obligation, including pledges to brokers or dealers who may from time to time effect distributions of Securities, and, in the case of any collateral call or default on such loan or obligation, pledges or sales of Securities by such pledgees or secured parties;

- short sales or transactions to cover short sales relating to the Securities;

- one or more exchanges or over the counter market transactions;

- through distribution by a selling securityholder or its successor in interest to its members, general or limited partners or shareholders (or their respective members, general or limited partners or shareholders);

- privately negotiated transactions;

- the writing of options, whether the options are listed on an options exchange or otherwise;

- distributions to creditors and equity holders of the selling securityholders; and

- any combination of the foregoing, or any other available means allowable under applicable law.

A selling securityholder may also resell all or a portion of its Securities in open market transactions in reliance upon Rule 144 under the Securities Act of 1933, as amended (the "**Securities Act**") provided it meets the criteria and conforms to the requirements of Rule 144 under the Securities Act and all applicable laws and regulations.

The selling securityholders may enter into sale, forward sale and derivative transactions with third parties, or may sell securities not covered by this prospectus to third parties in privately negotiated transactions. In connection with those sale, forward sale or derivative transactions, the third parties may sell securities covered by this prospectus, including in short sale transactions and by issuing securities that are not covered by this prospectus but are exchangeable for or represent beneficial interests in the common

stock. The third parties also may use shares of common stock received under those sale, forward sale or derivative arrangements or shares of common stock pledged by the selling securityholder or borrowed from the selling securityholders or others to settle such third-party sales or to close out any related open borrowings of common stock. The third parties may deliver this prospectus in connection with any such transactions. Any third party in such sale transactions will be an underwriter and will be identified in a supplement or a post-effective amendment to the registration statement of which this prospectus is a part, as may be required.

In addition, the selling securityholders may engage in hedging transactions with broker-dealers in connection with distributions of Securities or otherwise. In those transactions, broker-dealers may engage in short sales of securities in the course of hedging the positions they assume with selling securityholders. The selling securityholders may also sell securities short and redeliver securities to close out such short positions. The selling securityholders may also enter into option or other transactions with broker-dealers which require the delivery of securities to the broker-dealer. The broker-dealer may then resell or otherwise transfer such securities pursuant to this prospectus. The selling securityholders also may loan or pledge Securities, and the borrower or pledgee may sell or otherwise transfer the Securities so loaned or pledged pursuant to this prospectus. Such borrower or pledgee also may transfer those Securities to investors in our securities or the selling securityholders' securities or in connection with the offering of other securities not covered by this prospectus.

To the extent necessary, the specific terms of the offering of Securities, including the specific Securities to be sold, the names of the selling securityholders, the respective purchase prices and public offering prices, the names of any underwriter, broker-dealer or agent, if any, and any applicable compensation in the form of discounts, concessions or commissions paid to underwriters or agents or paid or allowed to dealers will be set forth in a supplement to this prospectus or a post-effective amendment to this registration statement of which this prospectus forms a part. The selling securityholders may, or may authorize underwriters, dealers and agents to, solicit offers from specified institutions to purchase Securities from the selling securityholders. These sales may be made under "delayed delivery contracts" or other purchase contracts that provide for payment and delivery on a specified future date. If necessary, any such contracts will be described and be subject to the conditions set forth in a supplement to this prospectus or a post-effective amendment to this registration statement of which this prospectus forms a part.

Broker-dealers or agents may receive compensation in the form of commissions, discounts or concessions from the selling securityholders. Broker-dealers or agents may also receive compensation from the purchasers of Securities for whom they act as agents or to whom they sell as principals, or both. Compensation to a particular broker-dealer might be in excess of customary commissions and will be in amounts to be negotiated in connection with transactions involving securities. In effecting sales, broker-dealers engaged by the selling securityholders may arrange for other broker-dealers to participate in the resales.

In connection with sales of Securities covered hereby, the selling securityholders and any underwriter, broker-dealer or agent and any other participating broker-dealer that executes sales for the selling securityholders may be deemed to be an "underwriter" within the meaning of the Securities Act.

Accordingly, any profits realized by the selling securityholders and any compensation earned by such underwriter, broker-dealer or agent may be deemed to be underwriting discounts and commissions. Selling securityholders who are “underwriters” under the Securities Act must deliver this prospectus in the manner required by the Securities Act. This prospectus delivery requirement may be satisfied in accordance with Rule 153 under the Securities Act or satisfied in accordance with Rule 174 under the Securities Act.

We and the selling securityholders have agreed to indemnify each other against certain liabilities, including liabilities under the Securities Act. In addition, we or the selling securityholders may agree to indemnify any underwriters, broker-dealers and agents against or contribute to any payments the underwriters, broker-dealers or agents may be required to make with respect to, civil liabilities, including liabilities under the Securities Act. Underwriters, broker-dealers and agents and their affiliates are permitted to be customers of, engage in transactions with, or perform services for us and our affiliates or the selling securityholders or their affiliates in the ordinary course of business.

The selling securityholders will be subject to the applicable provisions of Regulation M of the Securities Exchange Act of 1934 and the rules and regulations thereunder, which provisions may limit the timing of purchases and sales of any of the Securities by the selling securityholders. Regulation M may also restrict the ability of any person engaged in the distribution of the Securities to engage in market-making activities with respect to the Securities. These restrictions may affect the marketability of such Securities.

In order to comply with applicable securities laws of some states or countries, the Securities may only be sold in those jurisdictions through registered or licensed brokers or dealers and in compliance with applicable laws and regulations. In addition, in certain states or countries the Securities may not be sold unless they have been registered or qualified for sale in the applicable state or country or an exemption from the registration or qualification requirements is available. In addition, any Securities of a selling securityholder covered by this prospectus that qualify for sale pursuant to Rule 144 under the Securities Act may be sold in open market transactions under Rule 144 rather than pursuant to this prospectus.

In connection with an offering of Securities under this prospectus, the underwriters may purchase and sell securities in the open market. These transactions may include short sales, stabilizing transactions and purchases to cover positions created by short sales. Short sales involve the sale by the underwriters of a greater number of securities than they are required to purchase in an offering. Stabilizing transactions consist of certain bids or purchases made for the purpose of preventing or retarding a decline in the market price of the securities while an offering is in progress.

The underwriters also may impose a penalty bid. This occurs when a particular underwriter repays to the underwriters a portion of the underwriting discount received by it because the underwriters have repurchased securities sold by or for the account of that underwriter in stabilizing or short-covering transactions.

These activities by the underwriters may stabilize, maintain or otherwise affect the market price of the Securities offered under this prospectus. As a result, the price of the Securities may be higher than the

price that otherwise might exist in the open market. If these activities are commenced, they may be discontinued by the underwriters at any time. These transactions may be effected on the Nasdaq Global Select Market or another securities exchange or automated quotation system, or in the over-the-counter market or otherwise.

[*Remainder of page intentionally left blank*]

EXHIBIT A

SUBSIDIARIES OF DICERNA PHARMACEUTICALS, INC.

NAME	JURISDICTION OF INCORPORATION
DICERNA SECURITY CORPORATION	DELAWARE
DICERNA CAYMAN (TO BE DISSOLVED ON OR BEFORE DECEMBER 31, 2019)	CAYMAN
DICERNA EU LIMITED	ENGLAND
DICERNA IRELAND LIMITED	IRELAND

Exhibit 10.52

FIRST AMENDMENT TO LEASE AGREEMENT

THIS FIRST AMENDMENT TO LEASE AGREEMENT (this "**First Amendment**") is entered into effective as of February 4, 2020 (the "**First Amendment Date**"), by and between WESTERN OFFICE PORTFOLIO PROPERTY OWNER LLC, a Delaware limited liability company ("**Landlord**"), and DICERNA PHARMACEUTICALS, INC., a Delaware corporation ("**Tenant**").

RECITALS:

A. Landlord, as landlord, and Tenant, as tenant, entered into that certain Lease Agreement dated August 26, 2019 (the "**Existing Lease**"), relating to the leasing of certain premises (the "**Current Premises**"), consisting of approximately 15,781 rentable square feet, commonly known as Suite 100 in the building located at 4949 Pearl East Circle, Boulder, Colorado 80301 (the "**Building**"), said Premises being more particularly described in the Existing Lease.

B. Landlord and Tenant desire (i) to provide for the leasing of the First Expansion Premises (as defined below), (ii) to establish the term of the Lease as to the First Expansion Premises, (iii) to establish the Basic Rent for the First Expansion Premises Term (as defined below), and (iv) to amend other terms of the Existing Lease, all subject and pursuant to the terms and conditions set forth below.

NOW, THEREFORE, for good and valuable consideration the receipt and adequacy of which are hereby acknowledged, Landlord and Tenant agree as follows:

AGREEMENT:

1. **Incorporation of Recitals**. The foregoing Recitals shall be incorporated as though fully set forth herein.

2. **First Expansion Premises**.

2.1 **Lease of the First Expansion Premises**. On the First Expansion Premises Commencement Date (as defined below), Landlord hereby leases to Tenant, and Tenant hereby leases from Landlord, those certain premises, commonly known as Suite 300, consisting of approximately 6,985 rentable square feet of space on the 3rd floor of the Building and being more particularly depicted on **Exhibit "A"** attached hereto and incorporated herein (the "**First Expansion Premises**").

2.2 **Condition of the First Expansion Premises**. Tenant acknowledges that neither Landlord nor any agent of Landlord has made any representation or warranty with respect to the First Expansion Premises or the Building or with respect to the suitability of any part of the same for the conduct of Tenant's business. The taking of possession of the First Expansion Premises by Tenant shall conclusively establish that the First Expansion Premises and the Building were at such time in a good and sanitary order, condition and repair acceptable to Tenant. Except as expressly set forth in Exhibit B attached hereto, Tenant shall be conclusively deemed to have accepted the First Expansion Premises "AS IS" in the condition existing on the First Expansion Premises Commencement Date, and to have waived all claims relating to the condition of the First Expansion Premises. Except as expressly set forth on Exhibit B attached hereto, Landlord shall not have any obligation to construct or install any improvements or alterations, or to pay for any such construction or installation, in or on the First Expansion Premises.

3. **Combined Premises; The Premises**. As used herein, the "**Combined Premises**" shall mean, collectively, (a) the Current Premises plus (b) the First Expansion Premises. Landlord and Tenant acknowledge and agree that (i) the Combined Premises shall consist of approximately 22,766 rentable square feet, subject to verification and adjustment with respect to the First Expansion Premises only, in accordance with the terms and conditions of Section 26.3 of the Existing Lease and (ii) the Combined Premises shall be identified as Suites 100 and 300 in the Building. From and after the First Expansion Premises Commencement Date, the Lease is amended such that all references in the Lease to the "Premises" shall be deemed to refer to the Combined Premises, except that in no event shall the fact that Tenant is conducting business in the First Expansion Premises trigger the Commencement Date with respect to the Existing Premises (which Commencement Date shall be governed by the Existing Lease).

4. **Term**.

4.1 **First Expansion Premises Term**. The term of the Lease for the First Expansion Premises (the "**First Expansion Premises Term**") shall commence on the First Expansion Premises Commencement Date and terminate on the Expiration Date (which is at 5:00 p.m. local time on the last day of the 87th full calendar month following the Commencement Date (as defined in the Existing Lease)), such that the Term as to the Current Premises and the First Expansion Premises Term are coterminous. From and after the First Expansion Premises Commencement Date, the Lease is amended such that all references in the Lease to the "**Term**" of the Lease shall be deemed to include reference to the First Expansion Premises Term.

4.2 **First Expansion Premises Commencement Date**. The date on which Landlord tenders possession of the First Expansion Premises to Tenant shall be the "**First Expansion Premises Commencement Date**". Landlord and Tenant presently anticipate that possession of the First Expansion Premises will be tendered to Tenant within three business days following Tenant's full execution and delivery of this First Amendment to Landlord. Except to the extent expressly included as part of the First Expansion Premises Work, as set forth on **Exhibit B** attached hereto, any Tenant improvements, alterations, repairs or maintenance to the First Expansion Premises shall be performed in accordance with Section 8 of the Existing Lease and at Tenant's sole cost and expense.

4.3 **Commencement Date Memorandum**. Promptly following the First Expansion Premises Commencement Date, Landlord and Tenant shall execute a commencement date memorandum, in the form of **Exhibit C** attached hereto (the "**Commencement Date Memorandum**"), acknowledging that Tenant has accepted possession of the First Expansion Premises, and reciting the exact First Expansion Premises Commencement Date. The failure by either party, or both parties, to execute the Commencement Date Memorandum shall not affect the rights or obligations of either party hereunder. The Commencement Date Memorandum, when so executed and delivered, shall be deemed to be a part of the Lease.

5. **Rent and Other Terms**.

5.1 **Monthly Base Rent**.

(a) For the Current Premises. Tenant shall continue to pay Rent as to the Current Premises pursuant to the terms and conditions of the Lease.

(b) For the First Expansion Premises. Beginning on the First Expansion Premises Commencement Date, and continuing throughout the First Expansion Premises Term, Tenant shall pay Basic Rent for the First Expansion Premises, accruing on and after the First Expansion Premises Commencement Date and monthly thereafter, as Basic Rent for the First Expansion Premises Term, as follows:

Months of the First Expansion Premises Term	Annual Basic Rent Rate Per Rentable Square Foot in the First Expansion Premises	Monthly Basic Rent
First Expansion Premises Commencement Date – 12	$26.00	$15,134.17
13 – 24	$26.78	$15,588.19
25 – 36	$27.58	$16,053.86
37 – 48	$28.41	$16,536.99
49 – 60	$29.26	$17,031.76
61 – 72	$30.14	$17,543.99
73 – 84	$31.05	$18,073.69

85 – Expiration Date	$31.98	$18,615.03

5.2 Tenant's Share of Operating Expenses.

(a) For the Current Premises. Tenant shall continue to pay Tenant's Proportionate Share of Operating Costs and Taxes for the Current Premises pursuant to the terms and conditions of the Existing Lease.

(b) For the First Expansion Premises. Beginning on the First Expansion Premises Commencement Date, and continuing throughout the First Expansion Premises Term, Tenant shall pay, in addition to Tenant's Proportionate Share of Operating Costs and Taxes for the Current Premises, Tenant's Proportionate Share of Operating Costs and Taxes for the First Expansion Premises. " **Tenant's Proportionate Share**" allocable to the First Expansion Premises shall mean that fraction, the numerator of which is the total number of rentable square feet of the First Expansion Premises *(i.e.* 6,985 square feet) and the denominator of which is the number of rentable square feet in the Building (*i.e.*, 29,201 square feet), and is equal to 23.92%, subject to adjustment in accordance with the terms and conditions of the Lease.

5.3 Tenant's Covenant to Pay Rent. Tenant agrees to pay to Landlord at Landlord's Address, or to such other persons, or at such other places designated by Landlord, without any prior demand therefor as set forth in the Lease and without any deduction or offset whatsoever, Basic Rent, Additional Rent and all other amounts due under the Lease during the First Expansion Premises Term (collectively, "**Rent**"). Basic Rent shall be paid monthly in advance on the first day of each month of the First Expansion Premises Term. Basic Rent shall be prorated for partial months within the First Expansion Premises Term. Unpaid Rent shall accrue interest at the Default Rate from the date due until paid. Tenant's covenant to pay Rent shall be independent of every other covenant in the Lease.

6. Continuation of Tenant's Options. Tenant's options to extend the Term as to the Current Premises for two additional terms of five years each, as set forth in Exhibit H to the Existing Lease, shall apply, mutatis mutandis, as to the First Expansion Premises.

7. Tender of Possession of the Current Premises. Landlord and Tenant acknowledge and agree that Tenant's full execution and delivery of the Lease to Landlord occurred on October 2, 2019 when Tenant delivered to Landlord Tenant's Letter of Credit. Therefore, (a) the Estimated Delivery Date shall mean April 2, 2020, (ii) the Liquidated Damages Date shall mean July 2, 2020, and (iii) the Delayed Delivery Termination Date shall mean April 2, 2021.

8. **Letter of Credit**.

8.1 Modification to Existing Lease. Section 26.5.6 of the Existing Lease is amended by deleting the table therein, and replacing it with the following:

Lease Month	Required Tenant's Letter of Credit Amount
1 – 36	$500,000.00
37 – The date that is 60 days after the end of the Term or any renewal Term	$350,000.00

8.2 Tenant's First Expansion Premises Letter of Credit. Concurrently with the execution and delivery of this First Amendment, Tenant shall deliver to Landlord, as collateral for the full performance by Tenant of all of its obligations under the Lease and for all losses and damages Landlord may suffer as a result of any default by Tenant under the Lease, a standby, unconditional, irrevocable, transferable letter of credit ("**Tenant's First Expansion Premises Letter of Credit**") in the form of Exhibit J to the Existing Lease and containing the terms required herein, in the face amount set forth in Section 26.5.6 of the existing Lease (as modified by Section 8.1 of this First Amendment) ("**Tenant's First Expansion Premises Letter of Credit Amount**"), naming Landlord as beneficiary, permitting multiple and partial draws

thereon, in compliance with all of the requirements as are applicable to Tenant's Letter of Credit (including satisfaction of Tenant's LC Issuer Requirements) and otherwise in form acceptable to Landlord in its sole discretion; provided however, that no delay in the delivery of the Tenant's First Expansion Premises Letter of Credit shall delay the First Expansion Premises Commencement Date.

From and after the date that Tenant delivers Tenant's First Expansion Premises Letter of Credit to Landlord, the Lease is amended such that all references in the Lease to the "**Tenant's Letter of Credit**" shall be deemed to refer to the Tenant's Letter of Credit and the Tenant's First Expansion Premises Letter of Credit.

9. **Parking**. From and after the First Expansion Premises Commencement Date, Exhibit G of the Existing Lease is amended such that the number of spaces being made available to Tenant in the Parking Area is increased from 47 to 68.

10. **Brokerage**. Neither Landlord nor Tenant has dealt with any broker or agent in connection with the negotiation or execution of this First Amendment, other than Lodge Commercial Partners, Inc. as Tenant's broker and WWR Real Estate Services, LLC as Landlord's broker, whose commissions shall be paid by Landlord pursuant to separate written agreements. Tenant and Landlord shall each indemnify the other against all costs, expenses, attorneys' fees, liens and other liability for commissions or other compensation claimed by any other broker or agent claiming the same by, through or under the indemnifying party.

11. **Confidentiality**. Section 25.22 of the Existing Lease is hereby incorporated herein as if fully set forth in the body of this First Amendment.

12. **General Provisions**.

12.1 **Ratification**. Tenant acknowledges that neither Landlord nor any agent of Landlord has made any representation or warranty with respect to the Combined Premises, the Building or the Complex, or with respect to the suitability of any part of the same for the conduct of Tenant's business. Tenant hereby ratifies and confirms its obligations under the Lease, and represents and warrants to Landlord that it has no defenses thereto. Tenant further confirms and ratifies that, as of the First Amendment Date, (i) the Existing Lease is and remains in good standing and in full force and effect and has not been modified except as provided by this First Amendment; (ii) Tenant has no claims, counterclaims, set-offs or defenses against Landlord arising out of the Lease or in any way relating thereto or arising out of any other transaction between Landlord and Tenant; and (iii) as of the First Amendment Date, there are no uncured defaults or unfulfilled obligations on the part of Landlord or Tenant.

12.2 **Scope of Amendment; Defined Terms**. Except as expressly provided in this First Amendment, the Existing Lease shall remain in full force and effect. Should any inconsistency arise between this First Amendment and the Existing Lease as to the specific matters which are the subject of this First Amendment, the terms and conditions of this First Amendment shall control. All capitalized terms used in this First Amendment and not defined herein shall have the meanings set forth in the Existing Lease unless the context clearly requires otherwise; provided, however, that the term "**Lease**" as used herein and, from and after the First Amendment Date, in the Existing Lease shall refer to the Existing Lease as modified by this First Amendment.

12.3 **Successors and Assigns**. This First Amendment shall be binding upon and inure to the benefit of the parties hereto and their heirs, personal representatives, successors and assigns.

12.4 **Entire Agreement**. The Existing Lease, as amended by this First Amendment, contains the entire agreement of Landlord and Tenant with respect to the subject matter hereof, and may not be amended or modified except by an instrument executed in writing by Landlord and Tenant.

12.5 **Power and Authority**. Tenant has not assigned or transferred any interest in the Lease and has full power and authority to execute this First Amendment.

12.6 **Counterparts**. This First Amendment may be executed in any number of counterparts, each of which shall be deemed to be an original, and all of such counterparts shall constitute one document. To facilitate execution of this First Amendment, the parties may execute and exchange, by telephone facsimile or electronic mail PDF, counterparts of the signature pages. Signature pages may be detached from the counterparts and attached to a single copy of this First Amendment to physically form one document.

12.7 **Attorneys' fees**. In the event of litigation arising out of or in connection with this First Amendment, the prevailing party shall be awarded reasonable attorneys' fees, costs and expenses.

12.8 **Governing Law**. This First Amendment shall be governed by and construed in accordance with the laws of the State of Colorado.

12.9 **No Option**. The submission of this document for examination and review does not constitute an option or an offer to lease space in the Building or an agreement to lease. This document shall have no binding effect on the parties unless and until executed by both Landlord and Tenant and will be effective only upon Landlord's execution of the same.

12.10 **List of Exhibits**. All exhibits and attachments attached hereto are incorporated herein by this reference.

Exhibit A - Outline of First Expansion Premises
Exhibit B - Tenant Finish First Expansion Premises Work: Allowance (Landlord Performs the First Expansion Premises Work)
Exhibit C - Form of Confirmation of Commencement Date Letter Exhibit D - Right of First Offer

[signature page follows]

IN WITNESS WHEREOF, Landlord and Tenant have caused this First Amendment to be executed as of the First Amendment Date.

LANDLORD:

WESTERN OFFICE PORTFOLIO PROPERTY OWNER LLC,
a Delaware limited liability company

By: /s/ Andrew Dremyuga

Name: Andrew Dremyuga

Title: Authorized Signatory

TENANT:

DICERNA PHARMACEUTICALS, INC. ,
a Delaware corporation ·

By: /s/ John B. Green/

Name: John B. Green

Title: Chief Financial Officer

EXHIBIT A
OUTLINE OF FIRST EXPANSION PREMISES

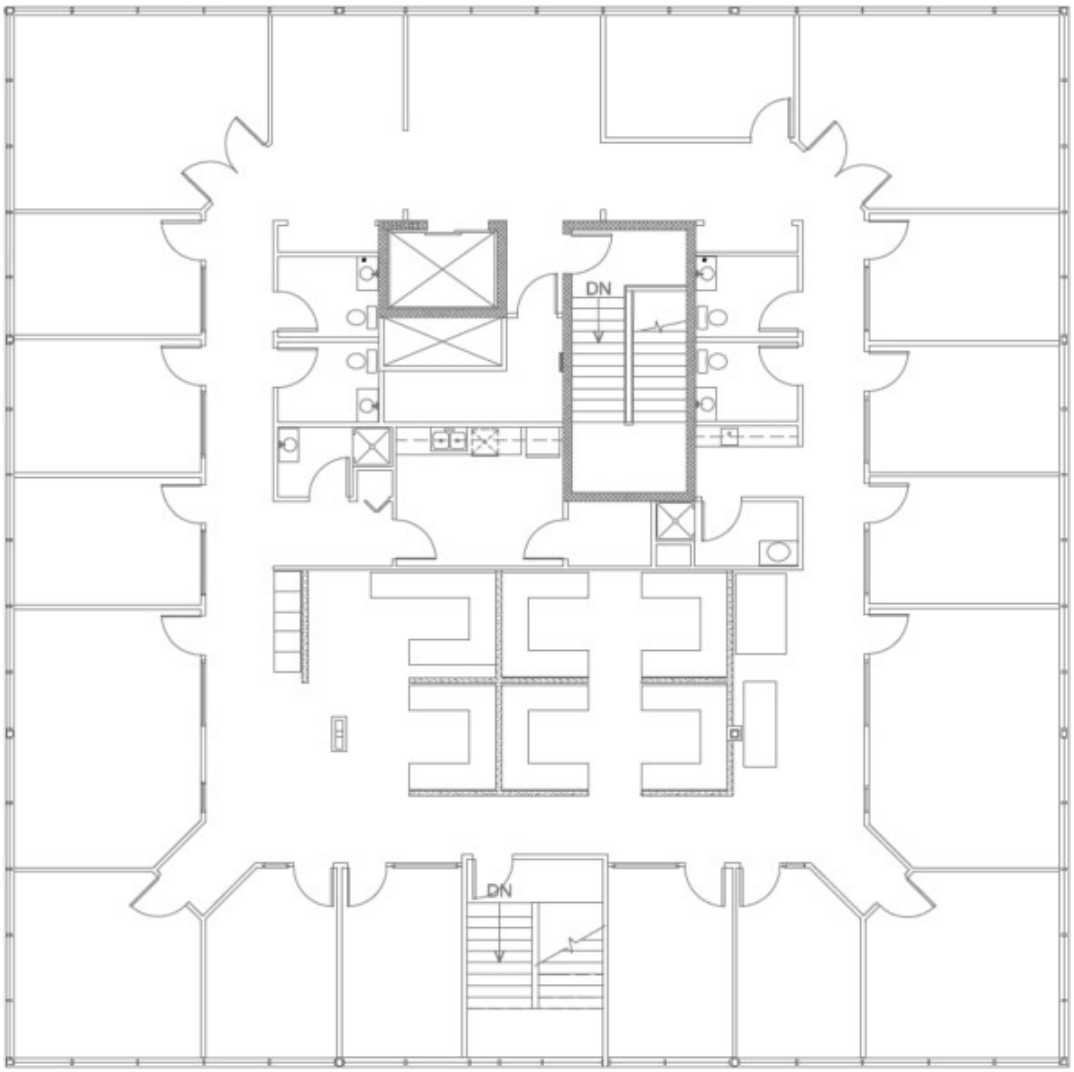

EXHIBIT B

TENANT FINISH-WORK: ALLOWANCE
(Landlord Performs the First Expansion Premises Work)

1. **Acceptance of First Expansion Premises**. Tenant accepts the First Expansion Premises in their "AS-IS" condition on the date that this First Amendment is entered into. Tenant intends to immediately accept Landlord's delivery of the First Expansion Premises and conduct business therein, and intends to vacate the First Expansion Premises on or around the date on which Landlord delivers the Current Premises to Tenant with the Work in the Current Premises Substantially Completed, pursuant to the terms of the Existing Lease. Landlord and Tenant acknowledge and agree that on or prior to the First Expansion Premises Vacation Date (as defined below), Tenant shall vacate the First Expansion Premises and remove all personnel and all furniture, fixtures and equipment installed by Tenant, all at Tenant's sole cost and expense, unless otherwise agreed to by Landlord in writing. Within 15 business days after the Work in the Current Premises is Substantially Completed, Landlord and Tenant will agree on a date by which Tenant shall vacate the First Expansion Premises (the "**First Expansion Premises Vacation Date**"); provided however, that if Landlord and Tenant fail agree on the First Expansion Premises Vacation Date within such 15 business day period, then the First Expansion Premises Vacation Date shall be the date that is 10 business days after the date on which the working drawings are fully approved (or deemed approved) by both Landlord and Tenant, as contemplated in Section 3.2 of this Exhibit. Tenant acknowledges and agrees that Landlord is not obligated to commence any First Expansion Premises Work, as contemplated by this Exhibit, unless and until Tenant vacates the First Expansion Premises pursuant to the terms of this Section 1.

2. **Space Plans**.

2.1 **Preparation and Delivery**. On or before the tenth day following date on which Landlord delivers the Current Premises to Tenant with the Work in the Current Premises Substantially Completed, pursuant to the terms of the Existing Lease (the "**First Amendment Space Plans Delivery Deadline**"), Tenant shall deliver to Landlord a space plan prepared by a design consultant reasonably acceptable to Landlord (the "**Architect**") depicting improvements to be installed in the First Expansion Premises (the "**First Expansion Premises Space Plans**").

2.2 **Approval Process**. Landlord shall notify Tenant whether it approves of the submitted First Expansion Premises Space Plans within five business days after Tenant's submission thereof. If Landlord disapproves of such First Expansion Premises Space Plans, then Landlord shall notify Tenant thereof specifying in reasonable detail the reasons for such disapproval, in which case Tenant shall, within five business days after such notice, revise such First Expansion Premises Space Plans in accordance with Landlord's objections and submit to Landlord for its review and approval. Landlord shall notify Tenant in writing whether it approves of the resubmitted First Expansion Premises Space Plans within three business days after its receipt thereof. This process shall be repeated until the First Expansion Premises Space Plans have been finally approved by Landlord and Tenant. If Landlord fails to notify Tenant that it disapproves of the initial First Expansion Premises Space Plans within five business days (or, in the case of resubmitted First Expansion Premises Space Plans, within three business days) after the submission thereof, then Landlord shall be deemed to have approved the First Expansion Premises Space Plans in question. If Tenant fails to timely deliver such First Expansion Premises Space Plans, then each day after the First Amendment Space Plans Delivery Deadline that such First Expansion Premises Space Plans are not delivered to Landlord shall be a Tenant Delay Day (defined below).

3. **First Expansion Premises Working Drawings**.

3.1 **Preparation and Delivery**. On or before the date which is 15 days following the final approval of the First Expansion Premises Space Plans, as outlined in Section 2 above, Landlord shall cause to be prepared final working drawings of all improvements to be installed in the First Expansion Premises and deliver the same to Tenant for its review and approval (which approval shall not be unreasonably withheld, delayed or conditioned). Such working drawings shall be prepared by Architect

or another design consultant selected by Landlord. Unless otherwise expressly included in the approved First Expansion Premises Space Plans to the contrary, the First Expansion Premises Work shall be performed utilizing Building-standard materials and other materials that are readily available.

3.2 **Approval Process**. Tenant shall notify Landlord in writing whether it approves of the submitted working drawings within five business days after Landlord's submission thereof. If Tenant disapproves of such working drawings, then Tenant shall notify Landlord thereof specifying in reasonable detail the reasons for such disapproval, in which case Landlord shall, within five business days after such notice, revise such working drawings in accordance with Tenant's objections and submit the revised working drawings to Tenant for its review and approval. Tenant shall notify Landlord in writing whether it approves of the resubmitted working drawings within three business days after its receipt thereof. This process shall be repeated until the working drawings have been finally approved by Landlord and Tenant. If Tenant fails to notify Landlord that it disapproves of the initial working drawings within five business days (or, in the case of resubmitted working drawings, within three business days) after the submission thereof, then Tenant shall be deemed to have approved the working drawings in question. Any delay caused by Tenant's unreasonable withholding of its consent or delay in giving its written approval as to such working drawings shall constitute a Tenant Delay Day. If the working drawings are not fully approved (or deemed approved) by both Landlord and Tenant by the 15th business day after the delivery of the initial draft thereof to Tenant, then each day after such time period that such working drawings are not fully approved (or deemed approved) by both Landlord and Tenant shall constitute a Tenant Delay Day.

3.3 **Landlord's Approval; Performance of First Expansion Premises Work**. If any of Tenant's proposed construction work will affect the Building's Structure or the Building's Systems, then the working drawings pertaining thereto must be approved by the Project's engineer of record. Landlord's approval of such working drawings shall not be unreasonably withheld, provided that (a) they comply with all Laws, (b) the improvements depicted thereon do not (1) adversely affect (in the reasonable discretion of Landlord) the Building's Structure or the Building's Systems (including the Project's restrooms or mechanical rooms), or (2) affect (in the sole discretion of Landlord) (A) the exterior appearance of the Project, (B) the appearance of the Project's common areas or elevator lobby areas, or (C) the provision of services to other occupants of the Project, (c) such working drawings are sufficiently detailed to allow construction of the improvements and associated work in a good and workmanlike manner for the entire First Expansion Premises, and (d) the improvements depicted thereon conform to the rules and regulations promulgated from time to time by Landlord for the construction of tenant improvements (a copy of which has been delivered to Tenant). As used herein, "**First Expansion Premises Working Drawings**" means the final working drawings approved by Landlord, as amended from time to time by any approved changes thereto, and "**First Expansion Premises Work**" means all improvements to be constructed by Landlord in accordance with and as indicated on the First Expansion Premises Working Drawings, together with any work required by governmental authorities to be made to other areas of the Project as a result of the improvements indicated by the First Expansion Premises Working Drawings. The First Expansion Premises Work shall include the installation of an appropriate conduit for the containment of fiber optic cables, such that Tenant can install fiber optic cables (i) between the Current Premises and Suite 100 MDF/Server Room, and (ii) between the First Expansion Premises and the Suite 300 IDF closet, and Landlord hereby grants Tenant reasonable access to such areas of the Project as required in order to complete such installation, provided that any such installations shall constitute Tenant's Off-Premises Equipment, as applicable. Landlord's approval of the First Expansion Premises Working Drawings shall not be a representation or warranty of Landlord that such drawings are adequate for any use or comply with any Law, but shall merely be the consent of Landlord thereto. Tenant shall, at Landlord's request, sign the First Expansion Premises Working Drawings to evidence its review and approval thereof. After the First Expansion Premises Working Drawings have been approved, Landlord shall cause the First Expansion Premises Work to be performed in substantial accordance with the First Expansion Premises Working Drawings, using contractors and subcontractors selected by Landlord**.**

4. **Bidding of First Expansion Premises Work**. Tenant has the right to elect to use the same general contractor as was selected for the Work in the Current Premises by providing written notice of such election to Landlord. If Tenant does not elect to use such contractor, then, prior to commencing the First Expansion Premises Work, Landlord shall competitively bid the First Expansion Premises Work to two contractors selected by Landlord and one contractor selected by the Tenant, and reasonably approved by Landlord. If the estimated First Expansion Premises Construction Costs are expected to exceed the First Expansion Premises Construction Allowance, Tenant shall be allowed to review the submitted bids from such contractors to value engineer any of Tenant's requested alterations. In such case, Tenant shall notify Landlord of any items in the First Expansion Premises Working Drawings that Tenant desires to change within five business days after Landlord's submission thereof to Tenant. If Tenant fails to notify Landlord of its election within such five business day period, Tenant shall be deemed to have approved the bids. Within seven business days following Landlord's submission of the initial construction bids to Tenant under the foregoing provisions (if applicable), Tenant shall have completed all of the following items: (a) finalized with Landlord's representative and the proposed contractor, the pricing of any requested revisions to the bids for the First Expansion Premises Work, and (b) approved in writing any overage in the First Expansion Premises Construction Costs in excess of the First Expansion Premises Construction Allowance, failing which each day after such seven business day period shall constitute a Tenant Delay Day. Tenant and Landlord acknowledge and agree that Tenant shall select the contractor for the First Expansion Premises Work based on the bids, provided however that Tenant's decision shall be subject to Landlord's reasonable approval of such contractor's bid.

5. **Change Orders**. Tenant may initiate changes in the First Expansion Premises Work. Each such change must receive the prior written approval of Landlord, such approval shall be granted or withheld in accordance with the standards set forth in Section 3.3 above; additionally, if any such requested change

might (a) delay the First Expansion Premises Commencement Date or (b) leave any portion of the First Expansion Premises not fully finished and ready for occupancy, Landlord may withhold its consent in its sole and absolute discretion. Landlord shall, upon completion of the First Expansion Premises Work, cause to be prepared accurate architectural, mechanical, electrical and plumbing "as-built" plans of the First Expansion Premises Work as constructed in both blueprint and electronic CADD format, which plan shall be incorporated into this 0 by this reference for all purposes. If Tenant requests any changes to the First Expansion Premises Work described in the First Expansion Premises Space Plans or the First Expansion Premises Working Drawings, then such increased costs and any additional design costs incurred in connection therewith as the result of any such change shall be added to the First Expansion Premises Construction Costs.

6. **Definitions**. As used herein, a "**Tenant Delay Day**" means each day of delay in the performance of the First Expansion Premises Work that occurs (a) because Tenant fails to timely furnish any information or deliver or approve any required documents such as the First Expansion Premises Space Plans or First Expansion Premises Working Drawings (whether preliminary, interim revisions or final), pricing estimates, construction bids, and the like, (b) because of any change by Tenant to the Space Plans or First Expansion Premises Working Drawings, (c) because Tenant fails to attend any meeting with Landlord, the Architect, any design professional, or any contractor, or their respective employees or representatives, as may be required or scheduled hereunder or otherwise necessary in connection with the preparation or completion of any construction documents, such as the First Expansion Premises Space Plans or First Expansion Premises Working Drawings, or in connection with the performance of the First Expansion Premises Work, (d) because of any specification by Tenant of materials or installations in addition to or other than Landlord's standard finish-out materials or any materials that are not readily available, or (e) because a Tenant Party otherwise delays completion of the First Expansion Premises Work. As used herein "**Substantial Completion**," "**Substantially Completed**," and any derivations thereof mean the First Expansion Premises Work in the First Expansion Premises is substantially completed (as reasonably determined by Landlord, including, if applicable, Landlord's receipt of a Letter of Completion or other similar approval from the City of Boulder) in substantial accordance with the First Expansion Premises Working Drawings. Substantial Completion shall have occurred even though minor details of construction, decoration, landscaping and mechanical adjustments remain to be completed by Landlord.

7. **Walk-Through; Punchlist**. When Landlord considers the First Expansion Premises Work in the First Expansion Premises to be Substantially Completed, Landlord will notify Tenant and,

within three business days thereafter, Landlord's representative and Tenant's representative shall conduct a walk-through of the First Expansion Premises and identify any necessary touch-up work, repairs and minor completion items that are necessary for final completion of the First Expansion Premises Work. Neither Landlord's representative nor Tenant's representative shall unreasonably withhold his or her agreement on punchlist items. Landlord shall use reasonable efforts to cause the contractor performing the First Expansion Premises Work to complete all punchlist items within 30 days after agreement thereon; however, Landlord shall not be obligated to engage overtime labor in order to complete such items.

8. **Excess Costs**. Tenant shall pay the entire amount by which the First Expansion Premises Construction Costs (hereinafter defined) exceed the First Expansion Premises Construction Allowance (hereinafter defined) (such excess amount being referred to herein as the "**Excess Amount**"). Upon approval of the First Expansion Premises Working Drawings and selection of a contractor, Tenant shall promptly (a) execute a work order agreement prepared by Landlord which identifies such drawings and itemizes the First Expansion Premises Construction Costs and sets forth the First Expansion Premises Construction Allowance, and (b) pay to Landlord 50% of Landlord's estimate of the Excess Amount. Within 30 days after Substantial Completion of the First Expansion Premises Work, Tenant shall pay to Landlord any remaining unpaid portion of the Excess Amount. In the event of default of payment of any portion of the Excess Amount, Landlord (in addition to all other remedies) shall have the same rights as for an Event of Default under this Lease. As used herein, "**First Expansion Premises Construction Costs**" means the entire cost of performing the First Expansion Premises Work, including design of and space planning for the First Expansion Premises Work and preparation of the First Expansion Premises Working Drawings and the final "as-built" plan of the First Expansion Premises Work, costs of construction labor and materials, electrical usage during construction, additional janitorial services, standard building directory and suite tenant signage, related taxes and insurance costs, licenses, permits, certifications, surveys and other approvals required by Law, any applicable governmental fees, and the construction supervision fee referenced in Section 11 of this Exhibit.

9. **First Expansion Premises Construction Allowance**. Landlord shall provide to Tenant a construction allowance not to exceed $60.00 per rentable square foot in the First Expansion Premises (the "**First Expansion Premises Construction Allowance**") to be applied toward the First Expansion Premises Construction Costs, as adjusted for any changes to the First Expansion Premises Work. The First Expansion Premises Construction Allowance shall not be disbursed to Tenant in cash, but shall be applied by Landlord to the payment of the First Expansion Premises Construction Costs, if, as, and when the cost of the First Expansion Premises Work is actually incurred and paid by Landlord. The First Expansion Premises Construction Allowance must be used (that is, the First Expansion Premises Work must be fully complete and the First Expansion Premises Construction Allowance disbursed) within 18 months following the First Expansion Premises Commencement Date (the "**Allowance Deadline**") or shall be deemed forfeited with no further obligation by Landlord with respect thereto, time being of the essence with respect thereto; provided, however, that if both parties are diligently pursuing completion of the First Expansion Premises Work, the Allowance Deadline will be extended by one day for each delay day caused by any force majeure event described in Section 25.3 of the Existing Lease. In no event shall any portion of the First Expansion Premises Construction Allowance be used towards the cost of the Work in the Existing Premises or towards the payment of Rent.

10. **First Expansion Premises Space Plan Allowance**. Landlord will provide up to $0.15 per rentable square foot of the First Expansion Premises (the "**First Expansion Premises Space Plan Allowance**") to be applied towards the costs incurred for Architect's preparation of the Space Plans. Tenant shall be responsible for any space planning costs incurred in excess of the First Expansion Premises Space Plan Allowance. The First Expansion Premises Space Plan Allowance is in addition to the First Expansion Premises Construction Allowance. In no event shall any portion of the First Expansion Premises Space Plan Allowance be used to fund any portion of the First Expansion Premises Construction Costs or to offset Tenant's Rent payments under the Lease. If the Architect is engaged by Landlord, and the cost of the space plan exceeds the First Expansion Premises Space Plan Allowance, such excess costs will be considered First Expansion Premises Construction Costs and payable by Tenant in accordance with Section 8 of this Exhibit. The First Expansion Premises Space Plan Allowance

shall not be disbursed to Tenant in cash, but shall be applied by Landlord to the payment of the First Expansion Premises Construction Costs, if, as, and when the cost of the First Expansion Premises Work is actually incurred and paid by Landlord. The First Expansion Premises Space Plan Allowance must be used (that is, the First Expansion Premises Work must be fully complete and the First Expansion Premises Space Plan Allowance disbursed) on or before the Allowance Deadline or shall be deemed forfeited with no further obligation by Landlord with respect thereto, time being of the essence with respect thereto; provided, however, that if both parties are diligently pursuing completion of the First Expansion Premises Work, the Allowance Deadline will be extended by one day for each delay day caused by any force majeure event described in Section 25.3 of the Existing Lease.

11. **Construction Management**. Landlord or its Affiliate or agent shall supervise the First Expansion Premises Work, make disbursements required to be made to the contractor, and act as a liaison between the contractor and Tenant and coordinate the relationship between the First Expansion Premises Work, the Project and the Building's Systems. Landlord or its Affiliate or agent shall use commercially reasonable efforts to coordinate weekly telephonic or in-person status meetings with Tenant's Representative. In consideration for Landlord's construction supervision services, Tenant shall pay to Landlord a construction supervision fee equal to five percent of the First Expansion Premises Construction Costs (exclusive of the construction supervision fee).

12. **Construction Representatives**. Landlord's and Tenant's representatives for coordination of construction and approval of change orders will be as follows, provided that either party may change its representative upon written notice to the other:

Landlord's Representative:	Rob Van Vleet c/o WWR Real Estate Services, LLC 1375 Walnut Street, Suite 10 Boulder, CO 80302 Telephone: 303.442.8687 Email: rob@wwreynolds.com
Tenant's Representative:	Rick Gurmendi Telephone: 303.884.4166 Email: rgurmendi@yahoo.com

13. **Miscellaneous**. To the extent not inconsistent with this Exhibit, Sections 8.1 and 21 of the Existing Lease shall govern the performance of the First Expansion Premises Work and Landlord's and Tenant's respective rights and obligations regarding the improvements installed pursuant thereto.

EXHIBIT C
CONFIRMATION OF FIRST EXPANSION PREMISES COMMENCEMENT DATE

__, 2020

Dicerna Pharmaceuticals, Inc. 4949 Pearl East Circle, Suite 100
Boulder, Colorado 80301

Re: Lease Agreement dated August 26, 2019 ("**Original Lease**"), as amended by the First Amendment to Lease Agreement dated January , 2020 ("**First Amendment**" and collectively with the Original Lease, the "**Lease**") between **WESTERN OFFICE PORTFOLIO PROPERTY OWNER LLC**, a Delaware limited liability company ("**Landlord**"), and **DICERNA PHARMACEUTICALS, INC.**, a Delaware corporation ("**Tenant**"). Capitalized terms used herein but not defined shall be given the meanings assigned to them in the First Amendment.

Ladies and Gentlemen:

Landlord and Tenant agree as follows:

1. **Condition of First Expansion Premises**. Tenant has accepted possession of the First Expansion Premises pursuant to the First Amendment. Furthermore, Tenant acknowledges that the First Expansion Premises are suitable for the Permitted Use.

2. **First Expansion Premises Commencement Date**. The First Expansion Premises Commencement Date is___, 2020.

3. **Expiration Date**. The First Expansion Premises Term shall be coterminous with the expiration of the Original Lease.

4. **Ratification**. Tenant hereby ratifies and confirms its obligations under the Lease, and represents and warrants to Landlord that it has no defenses thereto. Additionally, Tenant further confirms and ratifies that, as of the date hereof, (a) the Lease is and remains in good standing and in full force and effect, and (b) Tenant has no claims, counterclaims, set-offs or defenses against Landlord arising out of the Lease or in any way relating thereto or arising out of any other transaction between Landlord and Tenant.

5. **Binding Effect; Governing Law**. Except as modified hereby, the Lease shall remain in full effect and this letter shall be binding upon Landlord and Tenant and their respective successors and assigns. If any inconsistency exists or arises between the terms of this letter and the terms of the Lease, the terms of this letter shall prevail. This letter shall be governed by the laws of the state in which the Premises are located.

Please indicate your agreement to the above matters by signing this letter in the space indicated below and returning an executed original to us.

Sincerely,

__, on behalf of Landlord

By:__ Name:__ Title:___

Agreed and accepted:

DICERNA PHARMACEUTICALS, INC.,
a Delaware corporation

By:__ Name:__ Title:___

EXHIBIT D RIGHT OF FIRST OFFER

Subject to then-existing renewal or expansion options or other preferential rights of other tenants, Landlord shall, prior to offering any suite on the third floor of the Building that is adjacent to the First Expansion Premises (the "**Offer Space**") to any party (other than the then-current tenant or occupant therein), first offer to lease to Tenant the Offer Space in an "**AS-IS**" condition; such offer shall (a) be in writing, (b) specify the part of the Offer Space being offered to Tenant hereunder (the "**Designated Offer Space**"), and (c) specify the lease terms for the Designated Offer Space, including the rent to be paid for the Designated Offer Space and the date on which the Designated Offer Space shall be included in the Premises (the "**Offer Notice**"). The Offer Notice shall be substantially similar to the Offer Notice attached to this Exhibit. Tenant shall notify Landlord in writing whether Tenant elects to lease the entire Designated Offer Space on the terms set forth in the Offer Notice, within three days after Landlord delivers to Tenant the Offer Notice. If Tenant timely elects to lease the Designated Offer Space, then Landlord and Tenant shall execute an amendment to this Lease, effective as of the date the Designated Offer Space is to be included in the Premises, on the terms set forth in the Offer Notice and, to the extent not inconsistent with the Offer Notice terms, the terms of this Lease; however, Tenant shall accept the Designated Offer Space in an "**AS-IS**" condition and Landlord shall not provide to Tenant any allowances (e.g., moving allowance, construction allowance, and the like) or other tenant inducements except as specifically provided in the Offer Notice. Notwithstanding anything in this Exhibit to the contrary, if prior to Landlord's delivery to Tenant of the Offer Notice, Landlord has received a Third Party Offer to lease all or part of the Offer Space, and Landlord is willing to accept the terms of such Third Party Offer, and such Third Party Offer includes space in excess of the Offer Space, then Tenant must exercise its rights hereunder, if at all, as to all of the space contained in the Third Party Offer. To the extent that multiple tenants have rights to lease the Offer Space, Landlord may elect to deliver an Offer Notice to Tenant and such third party tenants at the same time, and if both Tenant and another third party tenant accept the Offer Notice, the party with the superior rights shall prevail.

If Tenant fails or is unable to timely exercise its right hereunder with respect to the Designated Offer Space, then such right shall lapse with respect to the Designated Offer Space, time being of the essence with respect to the exercise thereof (it being understood that Tenant's right hereunder is a one- time right only as to each Designated Offer Space the first time it is offered to Tenant hereunder), and Landlord may lease all or a portion of the Designated Offer Space to third parties on such terms as Landlord may elect. For purposes hereof, if an Offer Notice provides for an expansion, right of first refusal, or other preferential right to lease some of the remaining portion of the Offer Space, then such remaining portion of the Offer Space shall thereafter be excluded from the provisions of this Exhibit. Unless otherwise agreed in writing by Landlord and Tenant's real estate broker, in no event shall Landlord be obligated to pay a commission with respect to any space leased by Tenant under this Exhibit, and Tenant and Landlord shall each indemnify the other against all costs, expenses, attorneys' fees, and other liability for commissions or other compensation claimed by any broker or agent claiming the same by, through or under the indemnifying party.

Tenant's rights under this Exhibit shall terminate, at Landlord's option, if (a) an Event of Default exists as of the date of Tenant's exercise of its rights under this Exhibit or as of the effective date of the addition of the Designated Offer Space to the Premises, (b) the Lease or Tenant's right to possession of any of the Premises is terminated, (c) Tenant assigns its interest in the Lease or sublets any portion of the Premises, (d) Tenant fails to lease from Landlord and occupy at least the same number of rentable square feet leased to Tenant as of the First Expansion Premises Commencement Date, (e) Landlord determines, in its sole but reasonable discretion, that Tenant's financial condition or creditworthiness has materially deteriorated since the date of the First Amendment, (f) Tenant fails to timely exercise its option under this Exhibit, time being of the essence with respect to Tenant's exercise thereof, or (g) less than two full calendar years remain in the initial Term of the Lease.

Tenant's rights under this Exhibit shall not apply to leases that allow tenants in the Building to use such space as unfinished storage area and other temporary leases to provide temporary space to tenants

that ultimately will occupy other space in the Building on a permanent basis, any management space, tenant relocation space and other building space/amenities (conference center, fitness center, etc.).

FORM OF OFFER NOTICE

[Insert Date of Notice]

BY FEDEX

Dicerna Pharmaceuticals, Inc. 4949 Pearl East Circle, Suite 100
Boulder, Colorado 80301

Re: Lease Agreement dated August 26, 2019 ("**Original Lease**"), as amended by the First Amendment to Lease Agreement dated January , 2020 ("**First Amendment**" and collectively with the Original Lease, the "**Lease**") between **WESTERN OFFICE PORTFOLIO PROPERTY OWNER LLC**, a Delaware limited liability company ("**Landlord**"), and **DICERNA PHARMACEUTICALS, INC.**, a Delaware corporation ("**Tenant**"). Capitalized terms used herein but not defined shall be given the meanings assigned to them in the Lease.

Ladies and Gentlemen:

Pursuant to the Right of First Offer attached to the First Amendment, this is an Offer Notice on Suite___. The basic terms and conditions are as follows:

LOCATION: ___

SIZE: ___rentable square feet

BASIC RENT RATE: Initially, $___per rentable square foot in the Designated Offer Space, with___% annual increases

TERM: ___

IMPROVEMENTS: ___

COMMENCEMENT: ___

PARKING TERMS: ___

OTHER MATERIAL TERMS: ___

Under the terms of the Right of First Offer, you must exercise your rights, if at all, as to the Designated Offer Space on the depiction attached to this Offer Notice within three days after Landlord delivers such Offer Notice. Accordingly, you have until 5:00 p.m. local time on ___, 20 , to exercise your rights under the Right of First Offer and accept the terms as contained herein, failing which your rights under the Right of First Offer shall terminate and Landlord shall be free to lease the Designated Offer Space to any third party. If possible, any earlier response would be appreciated. Please note that your acceptance of this Offer Notice shall be irrevocable and may not be rescinded.

Upon receipt of your acceptance herein, Landlord and Tenant shall execute an amendment to the Lease memorializing the terms of this Offer Notice including the inclusion of the Designated Offer Space in the Premises; provided, however, that the failure by Landlord and Tenant to execute such amendment

shall not affect the inclusion of such Designated Offer Space in the Premises in accordance with this Offer Notice.

THE FAILURE TO ACCEPT THIS OFFER NOTICE BY (a) DESIGNATING THE “ACCEPTED” BOX, AND (b) EXECUTING AND RETURNING THIS OFFER NOTICE TO LANDLORD WITHOUT MODIFICATION WITHIN SUCH TIME PERIOD SHALL BE DEEMED A WAIVER OF TENANT’S RIGHTS UNDER THE RIGHT OF FIRST OFFER, AND TENANT SHALL HAVE NO FURTHER RIGHTS TO THE DESIGNATED OFFER SPACE. THE FAILURE TO EXECUTE THIS LETTER WITHIN SUCH TIME PERIOD SHALL BE DEEMED A WAIVER OF THIS OFFER NOTICE.

Should you have any questions, do not hesitate to call.

Sincerely,

__, on behalf of Landlord

By:___

Name:___

Title:___

[please check appropriate box] ACCEPTED ☐

REJECTED ☐

By:__ Name:__ Title:__ Date:___

Enclosure *[attach depiction of Designated Offer Space]*

75 HAYDEN AVENUE

LEXINGTON, MASSACHUSETTS 02421 LEASE SUMMARY SHEET

Execution Date:	January 14, 2020
Tenant:	**DICERNA PHARMACEUTICALS, INC.**, a Delaware corporation
Tenant's Mailing Address:	33 Hayden Avenue Lexington, MA 02421 Attn: David W. Miller, PhD, SVP
Landlord:	**HCP/KING 75 HAYDEN LLC**, a Delaware limited liability company
Building:	75 Hayden Avenue, Lexington, Massachusetts 02421. The Building is currently under construction and shall consist of four (4) stories and contain approximately 214,440 rentable square feet. The land (the "**Land**") on which the Building is located is described as "**Building 75**" on Exhibit 2A attached hereto and made a part hereof.
Campus:	All of the land described on Exhibit 2B (including the Land described above, which Land is a portion of the land described on Exhibit 2B) together with the Building described above, the buildings now known as and numbered 45 Hayden Avenue, 55 Hayden Avenue and 65 Hayden Avenue ("**Building 65**"), and any other building and/or improvements constructed on the Land. The Campus includes an existing nine-story garage with 1,091 spaces (the "**Garage**") which is used in common by the tenants of the Campus.
Premises:	Areas on the first (1st) floor, the fourth (4th) floor, the Penthouse and the roof of the Building, containing approximately 61,282 rentable square feet in the aggregate. The Premises consist of: **Prime Premises**, which will be located on the entire fourth (4th) floor; **PH System Premises**, which will be located on the first (1st) floor. The PH System Premises are located in a common room (the "**PH System Room**") which contains the PH systems of other tenants; **Storage Premises**, which will be located on the first (1st) floor. The Storage Premises are located in a common room (the "**Storage Room**") which contains storage areas of other tenants; and

	Penthouse Equipment Premises, which will be located on the Penthouse floor. The Penthouse Equipment Premises are located in a common room (the "**Penthouse Equipment Room**") which contains equipment of other tenants. **Generator Area**, as defined in Section 1.3(c), which will be located on the roof. The term "**Premises**" shall mean the Prime Premises, PH System Premises, Storage Premises, Penthouse Equipment Premises and Generator Area, as applicable. The Premises are shown on the Lease Plans attached hereto as Exhibit 1A, Exhibit 1B, Exhibit 1C, Exhibit 1D, and Exhibit 1E and made a part hereof. Landlord and Tenant stipulate and agree that the Rentable Square Footage of the Building and the Rentable Square Footage of the Premises are correct and shall not be remeasured.
Property:	The Building, the Garage, the Land, and other improvements located on, and to be constructed on, the Land.
Parking Areas:	The parking structures (surface lots and parking decks, including the Garage adjacent to the Building) located on the Campus that Landlord provides for parking by all tenants of space on the Property. The parties acknowledge that the parking garage serving 65 Hayden Avenue is not included in the Parking Areas.
Term Commencement Date:	The earlier of (i) the date that Tenant first commences to use the Premises, or any portion thereof, for any Permitted Use or (ii) the Substantial Completion, as hereinafter defined, of Base Building Work, as hereinafter defined, and the Tenant Improvement Work, as hereinafter defined. The parties estimate that that the Term Commencement Date will occur on or about October 1, 2020 ("**Estimated Term Commencement Date**").
Rent Commencement Date:	The date that is five (5) months after the Term Commencement Date.
Expiration Date:	Ten (10) years after the Rent Commencement Date, except that if the Rent Commencement Date does not occur on the first day of a calendar month, then the Expiration Date shall be the last day of the calendar month in which the date ten (10) years after the Rent Commencement Date occurs.
Extension Term(s):	Subject to Section 1.2 below, two (2) extension term(s) of five (5) years each.

Landlord's Contribution: $6,128,200 (i.e., $100.00 per rentable square foot of the Premises)

Permitted Uses: Subject to Legal Requirements, Tenant shall have the right to use the following portions of the Premises only for the following uses:

Prime Premises: General office, research, development, warehouse and laboratory use, and other ancillary uses related to the foregoing;

PH System Premises: Operation and maintenance of Tenant's Acid Neutralization Tank;

Storage Premises: Subject to Section 17.1 hereof, storage of Tenant's Hazardous Materials, waste and other materials used or generated by Tenant in the Premises; and

Penthouse Equipment Premises: Installation, operation and maintenance of Tenant's Penthouse Equipment.

Base Rent:

RENT YEAR	ANNUAL BASE RENT	MONTHLY PAYMENT
Rent Year 1	$3,646,279.00*	$303,856.58*
Rent Year 2	$3,755,973.78	$312,997.82
Rent Year 3	$3,868,732.66	$322,394.39
Rent Year 4	$3,984,555.64	$332,046.30
Rent Year 5	$4,104,055.54	$342,004.63
Rent Year 6	$4,227,232.36	$352,269.36
Rent Year 7	$4,354,086.10	$362,840.51
Rent Year 8	$4,484,616.76	$373,718.06
Rent Year 9	$4,619,437.16	$384,953.10
Rent Year 10	$4,757,934.48	$396,494.54

Rent Year: Rent Year 1 shall be the twelve-(12)-month period commencing as of the Rent Commencement Date, except that if the Rent Commencement Date occurs on other than the first day of a calendar month, then Rent Year 1 shall commence as of the Rent Commencement Date and shall end on the last day of the calendar year in which the first anniversary of the Rent Commencement Date occurs. Each Rent Year after Rent Year 1 shall be the twelve-(12)-month
period immediately following the preceding Rent Year.

Operating Costs and Taxes:	See Sections 5.2 and 5.3.
Tenant's Share:	A fraction, the numerator of which is the number of rentable square feet in the Premises and the denominator of which is the number of rentable square feet in the Building. As of the Execution Date, Tenant's Share with respect to the Premises is 28.58%.
Security Deposit/ Letter of Credit:	$1,519,282.90
Guarantor:	None.

EXHIBIT 1A	LEASE PLAN - PRIME PREMISES
EXHIBIT 1B	LEASE PLAN - PH SYSTEM PREMISES
EXHIBIT 1C	LEASE PLAN - STORAGE PREMISES
EXHIBIT 1D	LEASE PLAN – PENTHOUSE EQUIPMENT PREMISES AND GENERATOR AREA
EXHIBIT 2A	LEGAL DESCRIPTION - LAND
EXHIBIT 2B	LEGAL DESCRIPTION
EXHIBIT 3	PARKING AREAS
EXHIBIT 4	WORK LETTER
EXHIBIT 4-1	BASE BUILDING PLANS
EXHIBIT 4-2	TENANT/LANDLORD RESPONSIBILITY MATRIX
EXHIBIT 4-3	TENANT SCHEMATIC PLAN
EXHIBIT 5	BASE BUILDING CAPACITIES
EXHIBIT 6	FORM OF LETTER OF CREDIT
EXHIBIT 7	LANDLORD'S SERVICES
EXHIBIT 8	[Intentionally Deleted]
EXHIBIT 9-1	BUILDING RULES AND REGULATIONS
EXHIBIT 9-2	CONSTRUCTION RULES AND REGULATIONS
EXHIBIT 10	TENANT WORK INSURANCE SCHEDULE
EXHIBIT 11	[Intentionally Deleted]
EXHIBIT 12	PLAN—LOADING DOCKS, RECEPTION AREA, AND FREIGHT ELEVATORS

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THIS INDENTURE OF LEASE (this "**Lease**") is hereby made and entered into on the Execution Date by and between Landlord and Tenant.

Each reference in this Lease to any of the terms and titles contained in any Exhibit attached to this Lease shall be deemed and construed to incorporate the data stated under that term or title in such Exhibit. All capitalized terms not otherwise defined herein shall have the meanings ascribed to them as set forth in the Lease Summary Sheet which is attached hereto and incorporated herein by reference.

1. LEASE GRANT; TERM; APPURTENANT RIGHTS; EXCLUSIONS

1.1 Lease Grant. Landlord hereby leases to Tenant, and Tenant hereby leases from Landlord, the Premises upon and subject to terms and conditions of this Lease, for a term of years commencing on the Term Commencement Date and, unless earlier terminated or extended pursuant to the terms hereof, ending on the Expiration Date (the "**Initial Term**"; the Initial Term and any duly exercised Extension Terms are hereinafter collectively referred to as the "**Term**").

1.2 Extension Terms.

(a) Provided that the following conditions, which may be waived by Landlord in its sole discretion, are satisfied (i) Tenant, an Affiliated Entity (hereinafter defined) and/or a Successor (hereinafter defined) are then occupying at least sixty percent (60%) of the Premises; and (ii) no Event of Default then exists (1) as of the date of the Extension Notice (hereinafter defined), and (2) at the commencement of the applicable Extension Term (hereinafter defined), Tenant shall have the option to extend the Term for two (2) additional terms of five (5) years each (each, an "**Extension Term**"), commencing as of the expiration of the Initial Term, or the prior Extension Term, as the case may be. Tenant must exercise such option to extend, if at all, by giving Landlord written notice (each, an "**Extension Notice**") on or before the date that is twelve (12) months' prior to the expiration of the then-current term of this Lease, *time being of the essence*. Upon the timely giving of such notice, the Term shall be deemed extended for the applicable Extension Term upon all of the terms and conditions of this Lease, except that Base Rent during each Extension Term shall be calculated in accordance with this Section 1.2, Landlord shall have no obligation to construct or renovate the Premises, and Tenant shall have one (1) fewer option (in the case of the first Extension Term), or no further right (in the case of the second Extension Term), to extend the Term. If Tenant fails to give timely notice, as aforesaid, Tenant shall have no further right to extend the Term. Notwithstanding the fact that Tenant's proper and timely exercise of such option to extend the Term shall be self executing, the parties shall promptly execute a lease amendment reflecting such Extension Term after Tenant exercises such option. The execution of such lease amendment shall not be deemed to waive any of the conditions to Tenant's exercise of its rights under this Section 1.2.

(b) The Base Rent during each Extension Term (the "**Extension Term Base Rent**") shall be determined in accordance with the process described hereafter. Extension Term Base Rent shall be the greater of (i) Base Rent for the last Rent Year of the prior Term, or (ii) the fair market rental value of the Premises then demised to Tenant as of the commencement of the applicable Extension Term as determined in accordance with the process described below, for renewals of first class combination laboratory and office space in the Route 128/Route 2/Boston

Suburban West real estate market (the "**Market Area**") of equivalent quality, size, utility and location, with the length of the Extension Term, the credit standing of Tenant, and all other relevant factors to be taken into account. Within thirty (30) days after receipt of the Extension Notice, Landlord shall deliver to Tenant written notice of its determination of the Extension Term Base Rent for the applicable Extension Term. Tenant shall, within thirty (30) days after receipt of such notice, notify Landlord in writing whether Tenant accepts or rejects Landlord's determination of the Extension Term Base Rent ("**Tenant's Response Notice**"). If Tenant fails timely to deliver Tenant's Response Notice, Landlord's determination of the Extension Term Base Rent shall be binding on Tenant.

(c) If and only if Tenant's Response Notice is timely delivered to Landlord and indicates both that Tenant rejects Landlord's determination of the Extension Term Base Rent and desires to submit the matter to arbitration, then the Extension Term Base Rent shall be determined in accordance with the procedure set forth in this Section 1.2(c). In such event, within ten (10) days after receipt by Landlord of Tenant's Response Notice indicating Tenant's desire to submit the determination of the Extension Term Base Rent to arbitration, Tenant and Landlord shall each notify the other, in writing, of their respective selections of an appraiser (respectively, "**Landlord's Appraiser**" and "**Tenant's Appraiser**"). Landlord's Appraiser and Tenant's Appraiser shall then jointly select a third appraiser (the "**Third Appraiser**") within ten (10) days of their appointment. All of the appraisers selected shall be individuals with at least five (5) consecutive years' commercial appraisal experience for office and laboratory space in the area in which the Premises are located, shall be members of the Appraisal Institute (M.A.I.), and, in the case of the Third Appraiser, shall not have acted in any capacity for either Landlord or Tenant within five (5) years of his or her selection. The three appraisers shall determine the Extension Term Base Rent in accordance with the requirements and criteria set forth in Section 1.2(b) above, employing the method commonly known as Baseball Arbitration, whereby Landlord's Appraiser and Tenant's Appraiser each sets forth its determination of the Extension Term Base Rent as defined above, and the Third Appraiser must select one or the other (it being understood that the Third Appraiser shall be expressly prohibited from selecting a compromise figure). Landlord's Appraiser and Tenant's Appraiser shall deliver their determinations of the Extension Term Base Rent to the Third Appraiser within five (5) days of the appointment of the Third Appraiser and the Third Appraiser shall render his or her decision within ten (10) days after receipt of both of the other two determinations of the Extension Term Base Rent. The Third Appraiser's decision shall be binding on both Landlord and Tenant. Each party shall bear the cost of its own appraiser and the cost of the Third Appraiser shall be paid by the party whose determination is not selected.

1.3 Appurtenant Rights.

(a) Common Areas. Subject to the terms of this Lease and the Rules and Regulations (hereinafter defined), Tenant shall have, as appurtenant to the Premises, rights to use in common with others entitled thereto, the following areas (such areas are hereinafter referred to as the "**Common Areas**"): (i) the common loading docks, hallways, lobby, and elevator of the Building serving the Premises, (ii) the common lavatories located on the floor(s) on which the Premises are located, (iii) common walkways and driveways necessary for access to the Building,
(iv) the Parking Areas, and (v) other areas and facilities located in the Building, on the Land, or elsewhere on the Campus designated by Landlord from time to time for the common use of tenants of the Building and other entitled thereto; and no other appurtenant rights or easements. **"Rules**

and Regulations" shall be defined as the rules and regulations promulgated by Landlord pursuant to, and subject to, the provisions of Section 18.1 of this Lease. The two (2) loading docks, receiving area, and freight elevators shown on Exhibit 12, attached hereto and incorporated herein, are available for the use of the tenants in the Building and are part of the Common Areas.

(b) Parking. During the Term, Landlord shall, subject to the terms hereof, make available up to one hundred-fifty-three (153) parking spaces (inclusive of the Reserved Parking Spaces) for Tenant's use free of charge (except that the costs of maintenance and repair of the parking areas shall, subject to the provisions of Section 5.2, be included in Operating Costs) in the Garage (or, with respect to the Reserved Parking Spaces, within the executive parking area) as shown on Exhibit 3. The number of parking spaces in the parking areas reserved for Tenant, as modified pursuant to this Lease or as otherwise permitted by Landlord, are hereinafter referred to as the "**Parking Spaces**," and shall include five (5) reserved parking spaces located in the executive parking area located on the north side of the Building as shown in Exhibit 3 (the "**Reserved Parking Spaces**"). In addition to parking passenger motor vehicles, the Reserved Parking Spaces may be occupied by Tenant's shuttle van/vehicle for picking up and dropping off Tenant's employees. Tenant shall have no right to hypothecate or encumber the Parking Spaces, and shall not sublet, assign, or otherwise transfer the Parking Spaces other than to employees of Tenant occupying the Premises or to a Successor (hereinafter defined), an Affiliated Entity (hereinafter defined), or a transferee pursuant to an approved Transfer under Section 13 of this Lease. Subject to Landlord's right to reserve parking for other tenants of the Building, said Parking Spaces, except for the Reserved Parking Spaces, will be on an unassigned, non-reserved basis, and all Parking Spaces, including the Reserved Parking Spaces, shall be subject to such Rules and Regulations, as may be in effect for the use of the parking areas from time to time. Reserved and handicap parking spaces must be honored. Landlord has installed and shall maintain charging stations accommodating no fewer than eight (8) electrical vehicles on the first floor of the Garage for the non-exclusive use of Tenant and other occupants of the Campus. Notwithstanding anything to the contrary contained herein, in connection with maintenance, repairs or other construction activities, Landlord shall have the right, upon at least three (3) months' written notice to Tenant, temporarily to relocate all or any portion of the Parking Spaces in to other parking areas owned, controlled or leased by Landlord in the vicinity of the Property. Landlord shall use commercially reasonable efforts to minimize the period of any such relocation.

(c) Generator Area. Landlord shall demise and lease the Generator Area, as hereinafter defined, to Tenant, and Tenant shall hire and take the Generator Area from Landlord for the Lease Term. The "**Generator Area**" shall be defined as the area on the roof of the Building shown on Exhibit 1E attached hereto. Tenant shall have the right to use the Generator Area solely for the purpose of installing and using Tenant's own emergency generator ("**Tenant's Generator**") in accordance with the provisions of this Section 1.3(c). Tenant shall have the right to install Tenant's Generator in accordance with the terms and conditions of Article 11 below. Said demise of Tenant's Generator Area shall be upon all of the same terms and conditions of the Lease, except as set forth herein. Tenant shall not operate Tenant's Generator until Landlord has obtained copies of all required governmental permits, licenses, and authorizations necessary for the installation and operation of Tenant's Generator. In addition, Tenant shall comply with all reasonable construction rules and regulations promulgated by Landlord in the maintenance and operation of Tenant's Generator. Tenant shall be permitted to use Tenant's Generator Area solely for the maintenance and operation of Tenant's Generator, and Tenant's Generator and Generator Area are

solely for the benefit of Tenant. All electricity generated by Tenant's Generator may only be consumed by Tenant in the Premises.

(i) Tenant shall have no obligation to pay Base Rent in respect of Tenant's Generator Area.

(ii) Landlord shall have no obligation to provide any services to Tenant's Generator Area other than electricity which will be measured by a submeter in accordance with Section 9.1.

(iii) Tenant shall have no right to make any changes, alterations, additions, decorations or other improvements (collectively "**Installations**") to Tenant's Generator Area without Landlord's prior written consent, which consent Landlord may withhold in its sole but bona fide business judgment.

(iv) Tenant shall have no right to sublet Tenant's Generator Area or to assign its interest hereunder, other than to an Affiliated Entity or Successor as defined in Section
13.7 of this Lease or to a transferee pursuant to an approved Transfer under Section 13 of this Lease.

(v) In addition to and without limiting Tenant's obligations under the Lease, Tenant shall comply with all applicable environmental and fire prevention laws, ordinances and regulations in Tenant's use of Tenant's Generator Area.

(vi) In addition to and without limiting Tenant's obligations under the Lease, Tenant covenants and agrees that Tenant's use of Tenant's Generator and Installations shall not adversely affect the insurance coverage for the Building. If for any reason, the use of Tenant's Generator and/or the installation or use of the Installations shall result in an increase in the amount of the premiums for such coverage, then Tenant shall be liable for the full amount of any such increase.

(vii) Tenant shall, at Tenant's sole cost and expense, repair and maintain Tenant's Generator and Installations.

(viii) In addition to and without limiting the insurance provisions of the Lease, Tenant shall procure, keep in force and pay for Commercial General Liability Insurance in respect of Tenant's Generator Area satisfying the requirements of Section 14.1 of the Lease.

(ix) To the maximum extent permitted by Law, Tenant's Generator and all Installations in Tenant's Generator Area shall be at the sole risk of Tenant.

(x) In addition to and without limiting the indemnification provisions set forth in the Lease, Tenant shall, to the maximum extent permitted by law and subject to Section 14.5, indemnify, defend, and hold Landlord harmless from any and all claims, losses, demands, actions, or causes of actions suffered by any person, firm, corporation, or other entity arising from Tenant's use of Tenant's Generator Area, except to the extent caused by the negligent acts, negligent omissions or willful misconduct of Landlord or any Landlord Parties.

(d) Penthouse Equipment Premises. During the Term, Tenant shall have the right to use a portion of the Penthouse of the Building designated by Landlord (the "**Penthouse Equipment Premises**"), as shown on Exhibit 1D, for the installation of certain equipment approved by Landlord and purchased and installed by Tenant in accordance with the terms of this Lease (any equipment installed within the Penthouse Equipment Premises, as the same may be modified, altered or replaced during the Term, is collectively referred to herein as "**Tenant's Penthouse Equipment**"), including, without limitation, Section 11 hereof. Landlord's approval of such equipment shall not be unreasonably withheld, conditioned or delayed provided Tenant demonstrates to Landlord's reasonable satisfaction that the proposed equipment (i) does not interfere with any base building equipment operated by Landlord in the Penthouse; (ii) will not affect the structural integrity of the Building or impact the roof or the roof membrane in any manner; and (iii) shall be adequately sound-proofed to meet all requirements of Legal Requirements and Landlord's reasonable specified maximum decibel levels for equipment operations that is communicated to Tenant in advance of the installation of Tenant's Penthouse Equipment. Tenant shall not install or operate Tenant's Penthouse Equipment until Tenant has obtained and submitted to Landlord copies of all required governmental permits, licenses, and authorizations necessary for the installation and operation thereof. In addition, Tenant shall comply with all reasonable construction rules and regulations promulgated by Landlord in connection with the installation, maintenance and operation of Tenant's Penthouse Equipment. Landlord shall have no obligation to provide any services including, without limitation, electric current or gas service, to the Penthouse Equipment Premises or to Tenant's Penthouse Equipment; *provided however,* Tenant shall be permitted to connect to any such utilities and services as part of Tenant's installation of Tenant's Penthouse Equipment. Tenant shall be responsible for the cost of repairing and maintaining Tenant's Penthouse Equipment and the cost of repairing any damage to the Building, or the cost of any necessary improvements to the Building, caused by or as a result of the installation, replacement and/or removal of Tenant's Penthouse Equipment. Landlord makes no warranties or representations to Tenant as to the suitability of the Penthouse Equipment Premises for the installation and operation of Tenant's Penthouse Equipment. In the event that at any time during the Term, Landlord determines, in its sole but bona fide business judgment, that the operation and/or periodic testing of Tenant's Penthouse Equipment interferes with the operation of the Building or the business operations of any of the occupants of the Building, then Tenant shall, upon notice from Landlord, cause all further testing of Tenant's Penthouse Equipment to occur after normal business hours (hereinafter defined).

(e) Cafeteria. During the Term, Tenant, its employees, contractors, and visitors shall have the right to use the Cafeterias, as hereinafter defined, in common with others entitled thereto. The "**Cafeterias**" shall be defined as food services facilities which provide food to tenants and occupants of the Campus. As of the Execution Date: (i) one (1) Cafeteria is located in Building 55 (the "**Building 55 Cafeteria**"), and (ii) the normal operating hours of the Building 55 Cafeteria are from 7:30 a.m. to 1:30 p.m., Monday through Friday, excepting holidays. As of the Term Commencement Date, one (1) additional Cafeteria will be located in the Building and shall maintain normal operating hours no fewer than those maintained at the Building 55 Cafeteria. The quality of operations of the Cafeterias shall be consistent with the quality of food service operations in other suburban office buildings in the Boston area. Tenant hereby acknowledges that the Cafeterias may be relocated, from time to time, to other buildings located on the Campus. A third party provider is currently contemplated to operate the Cafeterias. Any amounts paid by Landlord on account of the operation of the Cafeterias in excess of the net revenues derived from the

operation of the Cafeterias shall be included in Operating Costs, as shall all of Landlord's costs of cleaning, maintaining, and repairing the Cafeterias. Card readers shall, at no cost to Tenant, be installed and maintained at appropriate access points to the Cafeterias and identification cards shall be issued to authorized users. Landlord will cooperate with Tenant to permit Tenant's employees to charge purchases from the Cafeterias to Tenant.

(f) Fitness Center. During the Term, Tenant, its employees and visitors shall have the right to use the Fitness Center, as hereinafter defined, without charge, in common with others entitled thereto. The "**Fitness Center**" shall be a work-out facility for the use of tenants and occupants of the Campus. As of the Execution Date, the Fitness Center is located in Building 65. Tenant acknowledges that the Fitness Center may be relocated, from time to time, to other buildings located on the Campus. Card readers shall, at no cost to Tenant, be installed and maintained at appropriate access points to the Fitness Center and identification cards shall be issued to authorized users. Users of the fitness center shall be required to execute such liability waivers as Landlord shall reasonably require. Any amounts paid by Landlord on account of the operation of the Fitness Center in excess of any net revenues derived from the operation of the Fitness Center shall be included in Operating Costs, as shall all of Landlord's costs of cleaning, maintaining, and repairing the Fitness Center.

(g) Bicycles. Tenant shall have the right to use in common with others a bicycle storage room to be installed by Landlord at its expense in the Building.

1.4 Tenant's Access.

(a) From and after the Term Commencement Date and until the end of the Term, Tenant shall have access to the Premises twenty-four (24) hours a day, seven (7) days a week, subject to Legal Requirements, the Rules and Regulations, the terms of this Lease and matters of record.

(b) Tenant and its employees shall have access to the Building after normal business hours by means of a card reader access system. In addition to the foregoing, Tenant shall have the right, subject to Tenant's obtaining Landlord's prior written approval of Tenant's plans and specifications therefor (which approval shall not be unreasonably withheld, delayed or conditioned), to install a security system within the Premises ("**Tenant's Security System Work**"). Tenant's Security System Work shall be performed in accordance with this Lease, including, without limitation, Section 11 hereof. Tenant shall provide Landlord and the cleaning personnel with access cards permitting normal entry to Tenant's Premises. In addition to the foregoing, such security system shall be designed with a master key override using the Building master key, so that Landlord shall have access to the Premises in an emergency, but Landlord shall only use such master key access in an emergency. Additionally, Tenant shall ensure that such system shall comply with all applicable laws, rules and regulations, including all fire safety laws, and in no event shall Landlord be liable for, and Tenant shall defend, indemnify, and hold harmless Landlord and its representatives and agents from and against, any claims, demands, liabilities, causes of action, suits, judgments, damages and expenses arising from such system or the malfunctioning thereof in accordance with Tenant's indemnity obligations set forth in Section 14.2.

(c) Subject to Section 11, Tenant shall have the right to access the Premises, at Tenant's sole risk, at least thirty (30) days before the Term Commencement Date for purposes reasonably related to the installation of Tenant's Work (as defined in Exhibit 4), provided such access does not materially interfere with the preparation for or performance of Landlord's Work (hereinafter defined). Tenant shall, prior to the first entry to the Premises pursuant to this Section 1.4(c), provide Landlord with certificates of insurance evidencing that the insurance required in Section 14 hereof is in full force and effect and covering any person or entity entering the Building. Tenant shall defend, indemnify and hold the Landlord Parties (hereinafter defined) harmless from and against any and all Claims (hereinafter defined) for injury to persons or property resulting from or relating to Tenant's access to and use of the Premises prior to the Term Commencement Date as provided under this Section 1.4(c). Tenant shall coordinate any access to the Premises prior to the Term Commencement Date with Landlord's property manager. If the exercise of Tenant's rights under this Section 1.4(c) results in a delay to Landlord's Work, the same shall constitute Tenant Delay (as that term is defined in Section 3.2(c)).

1.5 No recording // Notice of Lease. Neither party shall record this Lease. Tenant shall not record a memorandum of this Lease and/or a notice of this Lease. Notwithstanding the foregoing, if the Initial Term plus any Extension Term(s) exceed in the aggregate seven (7) years, Landlord agrees to join in the execution, in recordable form, of a statutory notice of lease and/or written declaration in which shall be stated the Term Commencement Date, the Rent Commencement Date, the number and length of the Extension Term(s) and the Expiration Date, which notice of lease may be recorded by Tenant with the Middlesex South Registry of Deeds and/or filed with the Middlesex South Registry District of the Land Court, as appropriate (alternatively and collectively, the "**Registry**") at Tenant's sole cost and expense. If a notice of lease was previously recorded with the Registry, upon the expiration or earlier termination of this Lease, Landlord shall deliver to Tenant a notice of termination of Lease and Tenant shall promptly execute, acknowledge, and deliver the same (together with any other instrument(s) that may be necessary in order to record and/or file same with the Registry) to Landlord for Landlord's execution and recordation with the Registry, which obligation shall survive the expiration or earlier termination of the Lease.

1.6 Exclusions. The following are expressly excluded from the Premises and reserved to Landlord: all the perimeter walls of the Premises (except the inner surfaces thereof), the Common Areas, and any space in or adjacent to the Premises used for shafts, stacks, pipes, conduits, wires and appurtenant fixtures, fan rooms, ducts, electric or other utilities, sinks or other Building facilities, and the use of all of the foregoing, except as expressly permitted pursuant to Section 1.3(a) above.

1.7 Acid Neutralization Tank.

(a) Tenant shall have the right, at any time during the Term, to install a separate acid neutralization tank ("**Tenant's Acid Neutralization Tank**") within the PH System Room for Tenant's exclusive use in accordance with the provisions of this Lease, including, without limitation, Section 11 hereof. In such event, Tenant shall have the right, throughout the Term of the Lease, as the same may be extended, to use Tenant's Acid Neutralization Tank in accordance with Legal Requirements. Tenant shall obtain, and maintain, all governmental permits and approvals necessary for the operation and maintenance of Tenant's Acid Neutralization Tank.

Tenant shall be responsible for all costs, charges and expenses incurred from time to time in connection with or arising out of the operation, use, maintenance, repair or refurbishment of Tenant's Acid Neutralization Tank, including all clean-up costs relating to Tenant's Acid Neutralization Tank.

(b) In the event Tenant installs Tenant's Acid Neutralization Tank as provided herein, Tenant shall be responsible for assuring that the maintenance and operation of Tenant's Acid Neutralization Tank shall in no way damage any portion of the Building or Property. To the maximum extent permitted by Law, Tenant's Acid Neutralization Tank and all appurtenances thereto shall be at the sole risk of Tenant, and Landlord shall have no liability to Tenant if Tenant's Acid Neutralization Tank or any appurtenant installations are damaged for any reason following the delivery of Tenant's Acid Neutralization Tank by Landlord in good working order and repair. Except for Landlord's or any Landlord Parties' negligence or willful misconduct, Tenant agrees to be responsible for any damage caused to the Building or Property in connection with the maintenance and operation of Tenant's Acid Neutralization Tank. Except (subject to Section 14.5) with respect to Claims, to the extent caused by the negligence or willful misconduct of Landlord or any Landlord Parties, Tenant shall indemnify, save, defend (at Landlord's option and with counsel reasonably acceptable to Landlord) and hold the Landlord Parties, as hereinafter defined, harmless from and against any and all Claims (as hereinafter defined), including (i) diminution in value of the Premises or any portion thereof, (ii) damages for the loss of or restriction on use of rentable or usable space of the Premises, (iii) damages arising from any adverse impact on marketing of space in the Premises or any portion thereof, and (iv) sums paid in settlement of Claims that arise during or after the Term as a result of Tenant's improper use of Tenant's Acid Neutralization Tank in violation of applicable Legal Requirements. This indemnification by Tenant includes costs actually incurred by Landlord: (1) in connection with any investigation required by any Governmental Authority of site conditions to the extent resulting from the breach by Tenant of its obligations with respect to the Acid Neutralization Tank, (2) in connection with any investigation required by Landlord pursuant to which it is determined that Tenant has breach its obligations with respect to Tenant's Acid Neutralization Tank, and (3) any clean-up, remediation, and/or removal of any Hazardous Materials and/or restoration of the Property required by any Governmental Authority caused by Tenant's improper use of Tenant's Acid Neutralization Tank.

(c) If Tenant elects to install Tenant's Acid Neutralization Tank as set forth in this Section 1.7, Tenant shall be responsible for the installation, operation, cleanliness, maintenance and removal of Tenant's Acid Neutralization Tank and the appurtenances, all of which shall remain the personal property of Tenant, and shall be removed by Tenant at its own expense at the expiration or earlier termination of the Lease. Tenant shall repair any damage caused by such removal, including the patching of any holes to match, as closely as possible, the color surrounding the area where Tenant's Acid Neutralization Tank and appurtenances were attached. Such maintenance and operation shall be performed in a manner to avoid any unreasonable interference with any other tenants or Landlord. Tenant shall take Tenant's Acid Neutralization Tank Premises "as is" in the condition in which the PH System Premises is in as of the Commencement Date, without any obligation on the part of Landlord to prepare or construct the PH System Premises for Tenant's use or occupancy. Without limiting the foregoing, Landlord makes no warranties or representations to Tenant as to the suitability of the PH System Premises for the installation and operation of Tenant's Acid Neutralization Tank. Tenant shall have no right

to make any changes, alterations, additions, decorations or other improvements to the PH System Premises without Landlord's prior written consent which shall not be unreasonably withheld, conditioned or delayed. Tenant agrees to maintain Tenant's Acid Neutralization Tank in good condition and repair.

(d) Landlord shall have no obligation to provide any services, including, without limitation, electric current, to Tenant's Acid Neutralization Tank.

(e) Tenant's Surrender Plan, as required pursuant to Section 21.2, shall include the decommissioning and removal of Tenant's Acid Neutralization Tank in accordance with applicable Law.

2. RIGHTS RESERVED TO LANDLORD

2.1 Additions and Alterations. Landlord reserves the right, at any time and from time to time, to make such changes, alterations, additions, improvements, repairs or replacements in or to the Property (including the Premises but, with respect to the Premises, only for purposes of repairs, maintenance, replacements and the exercise of any other rights expressly reserved to Landlord herein) and the fixtures and equipment therein, as well as in or to the street entrances and/or the Common Areas, as it may deem necessary or desirable, provided, however, that there be no material obstruction of permanent access to, or material interference with the use and enjoyment of, the Premises by Tenant or any material diminution of the quality of the Premises or Property as first class office and laboratory space. Subject to the foregoing, Landlord expressly reserves the right to temporarily close all, or any portion, of the Common Areas for the purpose of making repairs or changes hereto; provided however, Landlord will take reasonable steps to minimize the extent to which any repairs or alterations to the Common Areas disrupt the use of such Common Areas.

2.2 Additions to the Property.

(a) Landlord may at any time or from time to time (i) construct additional building(s) and improvements and related site improvements (collectively, "**Future Development**") in all or any part of the Property and/or (ii) change the location or arrangement of any improvement outside the Building in or on the Property or all or any part of the Common Areas, or add or deduct any land to or from the Property; provided that there shall be no material increase in Tenant's obligations or material interference with Tenant's rights under this Lease or material diminution of the quality of the Property as a first class office and laboratory space in connection with the exercise of the foregoing reserved rights.

(b) Tenant acknowledges and agrees that this Lease is subject and subordinate to (i) The Hayden Science Center Condominium (the "**Condominium**"), which was established by Master Deed dated December 1, 2017, recorded in Book 70325, Page 108, in the Middlesex South District Registry of Deeds and filed as Document No. 195793 in the Middlesex South Registry District of the Land Court, (ii) the Condominium Floor Plans and Site Plans dated December 1, 2017, and filed with the Middlesex Registry of Deeds, Southern District, as Plan No. 1090, Pages 1 through 13, and (iii) the Declaration of Trust of The Hayden Science Center Condominium Trust dated December 1, 2017, recorded in Book 70325, Page 148, in the Middlesex

South District Registry of Deeds and filed as Document No. 195794 in the Middlesex South Registry District of the Land Court (the Master Deed, Declaration of Trust, and the Plans are being referred to herein as the "**Condominium Documents**"). Tenant acknowledges and confirms that, as of the date hereof, the Building is not yet a Unit of the Condominium, provided, however, Landlord may amend the Master Deed to submit the Building to the provisions of Chapter 183A of the Massachusetts General Laws and to include the Building as a Unit of the Condominium. Tenant further agrees that the Condominium Documents, as so amended, may be further amended and that this Lease shall remain subject to and subordinate to the Condominium Documents, as so amended, so long as such amendments do not: not: (x) materially adversely affect Tenant's rights under this Lease, or (y) materially increase Tenant's obligations under this Lease. Landlord agrees to provide Tenant with copies of any such amendments at least ten (10) business days prior to recording same.

(c) Landlord and Tenant each hereby acknowledges and agrees that, in connection with any Future Development, (i) Landlord shall have the right to enter into, and subject the Property to the terms and conditions of, a commercially reasonable reciprocal easement agreement with any one or more of the neighboring property owners in order to create a commercial campus-like setting ("**REA**") provided that such REA does not (A) materially adversely affect Tenant's use of, or access to, the Premises, or (B) materially adversely affect the operation of Tenant's business from the Premises in accordance with the terms of this Lease, or Tenant's rights under and pursuant to the terms of this Lease, including without limitation Tenant's rights with respect to the Common Areas, or (C) result in any increase in Tenant's obligations under this Lease in more than a de minimus manner, or (D) materially diminish the quality of the Property as a first class office and laboratory space; (ii) upon Landlord's request in connection with the recording of the REA, Tenant shall execute a commercially reasonable instrument in recordable form making this Lease subject and subordinate to the REA; (iii) Landlord shall have the right to subdivide the Property so long as Tenant continues to have all of the rights and obligations contained in this Lease (e.g., the appurtenant right to use all Common Areas); and (iv) Tenant shall execute such reasonable documents (which may be in recordable form) evidencing the foregoing promptly upon Landlord's request.

(d) In case any excavation shall be made for building or improvements or for any other purpose upon the land adjacent to or near the Premises, Tenant will afford without charge to Landlord, or the person or persons, firms or corporations causing or making such excavation, license to enter upon the Premises for the purpose of doing such work as Landlord or such person or persons, firms or corporation shall deem to be necessary to preserve the walls or structures of the Building from injury, and to protect the Building by proper securing of foundations.

2.3 Name and Address of Building. Landlord reserves the right at any time and from time to time to change the name or address of the Building and/or the Property, provided Landlord gives Tenant at least three (3) months' prior written notice thereof and compensates Tenant for its reasonable, out of pocket cost of implementing such changes (e.g., replacement of letterhead and business cards).

2.4 Landlord's Access.

(a) Subject to the terms hereof, Tenant shall (a) upon reasonable advance notice, which may be oral (except that no notice shall be required in emergency situations), permit Landlord and any holder of a Mortgage (hereinafter defined) (each such holder, a "**Mortgagee**"), and the agents, representatives, employees and contractors of each of them, to have reasonable access to the Premises at all reasonable hours for the purposes of inspection, making repairs, replacements or improvements in or to the Premises or the Building or equipment therein (including, without limitation, sanitary, electrical, heating, air conditioning or other systems), complying with all applicable laws, ordinances, rules, regulations, statutes, by-laws, court decisions and orders and requirements of all public authorities (collectively, "**Legal Requirements**"), or exercising any right reserved to Landlord under this Lease (including without limitation the right to take upon or through, or to keep and store within the Premises all necessary materials, tools and equipment); (b) permit Landlord and its agents and employees, at reasonable times, upon reasonable advance notice, to show the Premises during normal business hours (i.e. Monday – Friday 8 A.M. - 6 P.M., Saturday 8 A.M. – 1 P.M., excluding holidays (i.e. New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day)) to any prospective Mortgagee or purchaser of the Building and/or the Property or of the interest of Landlord therein, and, during the last nine (9) months of the Term or at any time after the occurrence of an Event of Default, prospective tenants; and (c) upon reasonable prior written notice from Landlord, permit Landlord and its agents, at Landlord's sole cost and expense, to perform environmental audits, environmental site investigations and environmental site assessments ("**Site Assessments**") in, on, under and at the Premises and the Land, it being understood that Landlord shall repair any damage arising as a result of the Site Assessments, and such Site Assessments may include both above and below the ground testing and such other tests as may be necessary or appropriate to conduct the Site Assessments. In addition, to the extent that it is necessary to enter the Premises in order to access any area that serves any portion of the Building outside the Premises, then Tenant shall, upon as much advance notice as is practical under the circumstances, and in any event at least twenty-four (24) hours' prior written notice (except that no notice shall be required in emergency situations), permit contractors engaged by other occupants of the Building to pass through the Premises in order to access such areas but only if accompanied by a representative of Landlord. The parties agree and acknowledge that, despite reasonable and customary precautions (which Landlord agrees it shall exercise), any property or equipment in the Premises of a delicate, fragile or vulnerable nature may nevertheless be damaged in the course of performing Landlord's obligations. Accordingly, Tenant shall take reasonable protective precautions with unusually fragile, vulnerable or sensitive property and equipment. Nothing contained herein shall affect Landlord's liability for damage to Tenant's Property at the Premises as provided in Section 14.3 below.

2.5 Pipes, Ducts and Conduits. Tenant shall permit Landlord to erect, use, maintain and relocate pipes, ducts and conduits in and through the Premises, provided the same do not materially reduce the floor area or materially adversely affect the appearance thereof.

2.6 Minimize Interference; Tenant Representative. Except in the event of an emergency, Landlord shall use commercially reasonable efforts to minimize any interference with Tenant's business operations and use and occupancy of the Premises in connection with the exercise any of the foregoing rights under this Section 2. In addition, at any time that access to the Premises is allowed under this Section 2 (other than access to the Premises in the event of an emergency or for Premises cleaning and janitorial service), Tenant shall be permitted to have a

representative present at all times and, if Tenant deems it reasonably necessary, to require any individuals entering the Premises under this Section 2 to sign confidentiality agreements obligating such individuals to maintain the confidence of any information learned while in the Premises.

3. CONDITION OF PREMISES; CONSTRUCTION.

3.1 Condition of Premises.

(a) Subject to delays due to governmental regulation, unusual scarcity of or inability to obtain labor or materials, labor difficulties, casualty or other causes reasonably beyond Landlord's control (collectively "**Landlord's Force Majeure**") and subject to Tenant Delays (as defined in Section 3.2(c)), Landlord, at Landlord's sole cost and expense, shall perform the Landlord's Work (consisting of the Tenant Improvement Work, Landlord's Kitchen Work and the Base Building Work) as such terms are defined in Exhibit 4. All such work shall be performed in accordance with the terms and conditions of Exhibit 4.

(b) In the event that the Landlord's Work contains any defect which (i) was not known to Tenant prior to the Term Commencement Date, and (ii) could not have been discovered by Tenant undertaking reasonable inspections of the Property and Premises prior to the Term Commencement Date ("**Latent Defects**"), Landlord shall remediate such Latent Defects at Landlord's sole cost and expense and any delays due to the remediation of any such Latent Defects shall not be deemed to be Landlord's Force Majeure or a Tenant Delay provided that Tenant gives Landlord written notice of any such Latent Defect not later than one (1) year after the date of Substantial Completion of the applicable portion of Landlord's Work.

3.2 Landlord's Work.

(a) Subject to Landlord's Force Majeure, and subject to any Tenant Delay (as hereinafter defined), Landlord, at Landlord's sole cost and expense, shall perform the Landlord's Work (including the Base Building Work). All such work shall be performed in accordance with the terms and conditions of Exhibit 4.

(b) It is anticipated that the Base Building Work and Tenant Improvement Work shall be Substantially Complete on or before the Estimated Term Commencement Date. If the Base Building Work and Tenant Improvement Work are not Substantially Complete by November 15, 2020 due to reasons other than a Tenant Delay or Landlord's Force Majeure, then Tenant shall be entitled to a credit equal to the sum of the product of Nine Thousand Nine Hundred Eighty- Nine and 81/100 Dollars ($9,989.81) multiplied by the number of days that elapse after November 15, 2020 until the Base Building Work and Tenant Improvement Work are Substantially Compete. Any such credit granted to Tenant pursuant to the foregoing sentence shall be applied against the Base Rent otherwise owed by Tenant immediately following the Rent Commencement Date such that Tenant shall not owe any payments of Base Rent to Landlord until such credit is exhausted. The foregoing shall constitute Tenant's sole and exclusive remedy in the event of a delay in the occurrence of the Term Commencement Date beyond the Estimated Term Commencement Date.

(c) Definitions.

(i) "**Tenant Delay**" shall mean any act or omission by Tenant and/or Tenant's agents, employees or contractors (collectively with Tenant, the "**Tenant Parties**") which causes an actual delay in the performance of Landlord's Work. Notwithstanding the foregoing, except where a Tenant Delay arises from Tenant's failure timely to act within on or before a date or time period expressly set forth in the Lease (in which event no Tenant Delay Notice shall be required): (x) in no event shall any act or omission be deemed to be a Tenant Delay until and unless Landlord has given Tenant written notice (the "**Tenant Delay Notice**") advising Tenant (a) that a Tenant Delay is occurring, and (b) of the basis on which Landlord has determined that a Tenant Delay is occurring, and (y) no period of time prior to the time that Tenant receives a Tenant Delay Notice shall be included in the period of time charged to Tenant pursuant to such Tenant Delay Notice. Once Landlord's Contribution has been fully utilized, Tenant shall be pay for any increase in the cost to Landlord in the performance of Landlord's Work arising from any Tenant Delay within thirty (30) days of billing by Landlord.

(ii) "**Substantially Complete**" or "**Substantial Completion**," when referring to the Base Building Work and Tenant Improvement Work shall mean that: (1) the Base Building Work and Tenant Improvement Work are completed, other than minor work which does not materially affect Tenant's use of, or access to, the Premises, (2) the Premises and those portions of the Common Areas of the Building which affect Tenant's occupancy are in conformance with all applicable building codes, permits, laws and regulations, including without limitation, ADA,
(3) the Building amenities (including, without limitation, the Building Cafeteria, the lobby, library and locker room/showers), the Fitness Center and Garage shall be operational, (4) all structural elements and subsystems of the Building, including but not limited to HVAC, mechanical, electrical, lighting, plumbing, and life safety systems, will be in good working condition and repair,
(5) Landlord has delivered to Tenant a certificate of substantial completion from Landlord's architect stating that the Base Building Work and Tenant Improvement Work are substantially complete, and (6) such evidence (the "**Town Approval**") as is customarily provided by the Town of Lexington to evidence its acceptance of the Base Building Work and Tenant Improvement Work and Tenant's right to lawfully occupy the Premises (e.g., sign-offs on the Building permit by all applicable Town of Lexington departments or a certificate of occupancy, which may be a temporary certificate of occupancy) has been provided by the Town of Lexington; provided, however, that Substantial Completion shall be deemed to have occurred for purposes of clause (5) if (x) such required sign-offs are completed with respect to the Base Building Work and Tenant Improvement Work but cannot be completed for the entire Premises due to Tenant's failure to complete installation or work to be performed by Tenant (including furniture, wiring and cabling) in a manner that allows such required inspections to be completed and a temporary certificate of occupancy to be issued, or (y) approval of applicable governmental authorities required to permit legal occupancy of the Premises for the Permitted Uses cannot be obtained for the entire Premises due to Tenant's failure to complete installation of installation or work to be performed by Tenant (including furniture, wiring and cabling) in a manner that allows such approval to be obtained. No costs incurred by Landlord in satisfying the definition of Substantial Completion shall be included in Operating Costs. Notwithstanding anything to the contrary herein contained, in the event that the Base Building Work or Tenant Improvement Work is delayed beyond the Estimated Term Commencement Date by reason of any Tenant Delay, then Tenant shall be responsible to pay Rent for each day that Landlord would have achieved Substantial Completion of the Base Building Work or Tenant Improvement Work, as applicable, but for such Tenant Delay, notwithstanding that the Term Commencement Date may not yet have occurred.

(iii) "**Substantially Complete**" or "**Substantial Completion**," when referring to the Landlord's Kitchen Work shall mean that: (1) the Landlord's Kitchen Work is completed, other than minor work which does not materially affect Tenant's use of, or access to, such portion of the Premises as a commissary kitchen for in-house food preparation for service to Tenant's employees; (2) the Landlord's Kitchen Work is in conformance with all applicable building codes, permits, laws and regulations, including without limitation, ADA, (3) Landlord has delivered to Tenant a certificate of substantial completion from Landlord's architect stating that the Landlord's Kitchen Work is substantially complete, and (4) Town Approval has been provided by the Town of Lexington with respect to the Landlord's Kitchen Work. No costs incurred by Landlord in satisfying the definition of Substantial Completion shall be included in Operating Costs.

(iv) Punchlist. Promptly following delivery of the Premises to Tenant with the Base Building Work and Tenant Improvement Work, respectively, substantially complete, Landlord shall provide Tenant with a list (each, a "**Punchlist**") of outstanding items (in each case, the "**Punchlist Items**") which (a) need to be performed to complete the Base Building Work and Tenant Improvement Work, respectively, and (b) do not materially impair Tenant's ability to use the Premises for the Permitted Use. Promptly following Substantial Completion of the Landlord's Kitchen Work, Landlord shall provide Tenant with a list Punchlist Items with respect to Landlord's Kitchen Work. Subject to Landlord's Force Majeure and Tenant Delays, Landlord shall, unless otherwise specified on the Punchlist, complete all Punchlist Items within forty-five (45) days of the date of the Punchlist.

4. USE OF PREMISES

4.1 Permitted Uses. During the Term, Tenant shall use the Premises only for the Permitted Uses and for no other purposes. Service and utility areas (whether or not a part of the Premises) shall be used only for the particular purpose for which they are designed. Tenant shall keep the Premises equipped with appropriate safety appliances to the extent required by applicable laws or insurance requirements.

4.2 Prohibited Uses.

(a) Notwithstanding any other provision of this Lease, Tenant shall not use the Premises or the Building, or any part thereof, or suffer or permit the use or occupancy of the Premises or the Building or any part thereof by any of the Tenant Parties (i) in a manner which would violate any of the covenants, agreements, terms, provisions and conditions of this Lease or otherwise applicable to or binding upon the Premises; (ii) for any unlawful purposes or in any unlawful manner; (iii) which, in the reasonable judgment of Landlord (taking into account the use of the Building as a combination laboratory, research and development and office building and the Permitted Uses) shall (a) impair the appearance or reputation of the Building; (b) impair, interfere with or otherwise diminish the quality of any of the Building services or the proper and economic heating, cleaning, ventilating, air conditioning or other servicing of the Building or Premises, or the use or occupancy of any of the Common Areas; (c) occasion discomfort, inconvenience or annoyance in any material respect (and Tenant shall not install or use any electrical or other equipment of any kind (including, without limitation, Tenant's Rooftop Equipment) which, in the reasonable judgment of Landlord, will cause any such impairment, interference, discomfort,

inconvenience, annoyance or injury), or cause any injury or damage to any occupants of the Premises or other tenants or occupants of the Building or their property; or (d) cause harmful air emissions, laboratory odors or noises or any unusual or other objectionable odors, noises or emissions to emanate from the Premises; (iv) in a manner which is inconsistent with the operation and/or maintenance of the Building as a first-class combination office, research, development and laboratory facility; or (v) in a manner which shall increase such insurance rates on the Building or on property located therein over that applicable when Tenant first took occupancy of the Premises hereunder.

(b) With respect to the use and occupancy of the Premises and the Common Areas, Tenant will not: (i) place or maintain any signage (except as set forth in Section 12.2 below), trash, refuse or other articles in any vestibule or entry of the Premises, on the footwalks or corridors adjacent thereto or elsewhere on the exterior of the Premises, nor obstruct any driveway, corridor, footwalk, parking area, mall or any other Common Areas; (ii) permit undue accumulations of or burn garbage, trash, rubbish or other refuse within or without the Premises;
(iii) permit the parking of vehicles so as to interfere with the use of any driveway, corridor, footwalk, parking area, or other Common Areas; (iv) receive or ship articles of any kind outside of those areas reasonably designated by Landlord; (v) conduct or permit to be conducted any auction, going out of business sale, bankruptcy sale (unless directed by court order), or other similar type sale in or connected with the Premises; (vi) use the name of Landlord, or any of Landlord's affiliates in any publicity, promotion, trailer, press release, advertising, printed, or display materials without Landlord's prior written consent; or (vii) except in connection with Alterations (hereinafter defined) approved by Landlord, cause or permit any hole to be drilled or made in any part of the Building.

4.3 Transportation of Animals. No animals, animal waste, food or supplies relating to the animals maintained from time to time in the animal storage areas of the Premises shall be transported within the Building unless Tenant elects to install a vivarium, which installation shall be in accordance with all applicable provisions of this Lease (including without limitation Sections
4.6 and 11), and in such event, only as provided in this Section 4.3. All deliveries of animals or animal food or supplies to Tenant at the Building shall be made prior to 11:00 a.m. No transportation of animals, animal waste, food or supplies within the Building shall occur between the hours of 11:00 a.m. and 1:00 p.m. At all times that animals are transported within the Common Areas, they shall be transported in an appropriate cage or other container. At no time shall any animals, animal waste, food or supplies relating to the animals be brought into, transported through, or delivered to the lobby of the Building or be transported within the Building in elevators other than the freight elevator.

4.4 Chemical Safety Program. If at any time during the Term, Tenant's use of the Premises includes research, development, warehouse, laboratory use, or other ancillary uses related to the foregoing, Tenant shall establish and maintain a chemical safety program administered by a qualified individual (who, if required by Applicable Laws, shall be licensed),in accordance with the requirements of the Massachusetts Water Resources Authority ("**MWRA**") and any other applicable Governmental Authority. Tenant shall be solely responsible for all costs incurred in connection with such chemical safety program. Upon request by Landlord no more than twice per calendar year, Tenant shall provide Landlord with a certificate signed by a duly authorized representative of Tenant attesting to Tenant's compliance with the requirements of (a)

the MWRA and any other applicable Governmental Authority with respect to such chemical safety program and (b) this Section. Tenant shall obtain and maintain during the Term (i) any permit required by the MWRA ("**MWRA Permit**") and (ii) a wastewater treatment operator license from the Commonwealth of Massachusetts with respect to Tenant's use of any acid neutralization tank exclusively serving the Premises in the Building. Tenant shall not introduce anything into the acid neutralization tank serving the Premises, if any (x) in violation of the terms of the MWRA Permit,
(y) in violation of Legal Requirements or (z) that would interfere with the proper functioning of any such acid neutralization tank.

4.5 Parking and Traffic Demand Management Plan. The Property is subject to a Parking and Traffic Demand Management Plan with the Town of Lexington, for Expanded Multi- Tenant Life Science Center, for 45,55, 65, and 75 Hayden Avenue, Lexington, Massachusetts, updated December 6, 2017 (the "**Initial PTDM**"). Tenant agrees, at its sole expense, to comply with the requirements of the Initial PTDM, only insofar as they apply to the Premises and/or Tenant's use and occupancy thereof. In the event that the Initial PTDM is ever modified, supplemented, amended or replaced ("**PTDM Modifications**"), Tenant agrees, at its sole expense, to comply with the requirements of the PTDM Modifications, only insofar as they apply to the Premises and/or Tenant's use and occupancy thereof.

4.6 Vivarium. If Tenant desires to install a vivarium, and provided that Tenant, at its sole expense, obtains all governmental permits and approvals required therefor, Tenant shall have the right to install a vivarium in the Premises in accordance with the terms and conditions of Article 11 below. Tenant shall be responsible, at its sole expense, for the operations of the vivarium in accordance with all Legal Requirements and with best industry practices. Without limiting the general application of the foregoing, Tenant shall separately dispose of all waste products from the operation of the vivarium, including, without limitation, dead animals, strictly in accordance with Legal Requirements. Landlord shall have the right, from time to time by written notice to Tenant, to promulgate reasonable rules and regulations with respect to the operation of the vivarium so as to minimize any adverse effects that such operation may have on other occupants of the Building, including without limitation, regulations as to noise mitigation.

5. RENT; ADDITIONAL RENT

5.1 Base Rent. During the Term, commencing on the Rent Commencement Date, Tenant shall pay to Landlord Base Rent in equal monthly installments, in advance and without demand on the first day of each month for and with respect to such month. Unless otherwise expressly provided herein, the payment of additional rent and other charges reserved and covenanted to be paid under this Lease with respect to the Premises (other than Base Rent) shall commence on the Term Commencement Date. Base Rent and additional rent hereunder (collectively, "**Rent**") shall be prorated for any partial months. Rent shall be payable to Landlord or, if Landlord shall so direct in writing, to Landlord's agent or nominee, in lawful money of the United States which shall be legal tender for payment of all debts and dues, public and private, at the time of payment.

5.2 Operating Costs.

(a) "**Operating Costs**" shall mean all reasonable and verifiable costs incurred and expenditures of whatever nature made by Landlord in the operation, management, repair, replacement, maintenance and insurance of the Property or allocated to the Property, including without limitation all costs of labor (wages, salaries, fringe benefits, etc.) of individuals directly employed in the management/operation of the Property up to and including the Director of Property Management, however denominated, any costs for utilities supplied to exterior areas and the Common Areas, and any costs for repair and replacements, cleaning and maintenance of exterior areas and the Common Areas, related equipment, facilities and appurtenances and HVAC equipment, a management fee in the amount of four percent (4%) of gross Building revenues paid to Landlord's property manager (if not included in labor costs), the costs, including, without limitation, a commercially reasonable rental factor, of Landlord's management office for the Property, which management office may be located outside the Property and which may serve other properties in addition to the Property (in which event such costs shall be equitably allocated among the properties served by such office), the cost of operating any amenities in the Property available to all tenants of the Property and any subsidy provided by Landlord for or with respect to any such amenity, and all costs of applying and reporting for the Building or any part thereof to seek or maintain certification under the U.S. EPA's Energy Star® rating system, the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system or a similar system or standard. For costs and expenditures made by Landlord in connection with the operation, management, repair, replacement, maintenance and insurance of the Building as a whole, Landlord shall make a reasonable allocation thereof between the retail and non-retail portions of the Building, if applicable. The allocation of Operating Costs relating to the Common Areas of the Campus shall be made in accordance with the Condominium Documents. Operating Costs shall not include Excluded Costs (hereinafter defined).

(b) "**Excluded Costs**" shall be defined as (i) any mortgage charges (including interest, principal, points and fees); (ii) brokerage commissions; (iii) salaries of executives and owners not directly employed in the management/operation of the Property; (iv) the cost of work done by Landlord for a particular tenant; (v) the cost of items which, by generally accepted accounting principles, would be capitalized on the books of Landlord or are otherwise not properly chargeable against income, except to the extent such capital item is (A) required by any Legal Requirements or (B) reasonably projected to materially reduce Operating Costs; if such capital expenditures arise, the cost shall be amortized over the useful life of the applicable item, determined in accordance with generally accepted accounting principles, as consistently applied in the real estate industry; (vi) the costs of Landlord's Work and any contributions made by Landlord to any tenant of the Property in connection with the build-out of its premises; (vii) franchise or income taxes imposed on Landlord; (viii) costs paid directly by individual tenants to suppliers or directly to Landlord, including tenant HVAC, electricity, telephone and other utility costs; (ix) increases in premiums for insurance when such increase is caused by the use of the Building by Landlord or any other tenant of the Building; (x) depreciation of the Building; (xi) costs relating to maintaining Landlord's existence as a corporation, partnership or other entity;
(xii) advertising and other fees and costs incurred in procuring tenants; (xiii) the cost of any items for which Landlord is reimbursed by insurance, condemnation awards, refund, rebate or otherwise, and any expenses for repairs or maintenance to the extent covered by warranties, guaranties and service contracts; and (xiv) costs incurred in connection with any disputes between Landlord and its employees, between Landlord and Building management, or between Landlord and other tenants or occupants; (xv) Taxes; (xvi) except with respect to the management fee, any expenses

paid to Landlord or subsidiaries or affiliates of Landlord for goods and/or services in or to any portion of the Building to the extent that such expense exceeds the costs of such goods and/or services rendered by unaffiliated third parties on an arm's length, competitive basis; (xvii) costs related to events for the Building tenants including, but not limited to parties, holiday gifts and tenants welcoming gifts; or (xviii) costs arising from Landlord's charitable or political contributions.

(c) **Payment of Operating Costs**. Commencing as of the Term Commencement Date and continuing thereafter throughout the remainder of the Term of the Lease, Tenant shall pay to Landlord, as additional rent, Tenant's Share of Operating Costs. Landlord may make a good faith estimate of Tenant's Share of Operating Costs for any fiscal year or part thereof during the Term, and Tenant shall pay to Landlord, on the Term Commencement Date and on the first (1st) day of each calendar month thereafter, an amount equal to Tenant's Share of Operating Costs for such fiscal year and/or part thereof divided by the number of months therein. Landlord may estimate and re-estimate Tenant's Share of Operating Costs and deliver a copy of the estimate or re-estimate to Tenant. Thereafter, the monthly installments of Tenant's Share of Operating Costs shall be appropriately adjusted in accordance with the estimations so that, by the end of the fiscal year in question, Tenant shall have paid all of Tenant's Share of Operating Costs as estimated by Landlord. Any amounts paid based on such an estimate shall be subject to adjustment as herein provided when actual Operating Costs are available for each fiscal year. As of the Execution Date, the Property's fiscal year is January 1 – December 31.

(d) **Annual Reconciliation**. Landlord shall, within one hundred twenty (120) days after the end of each fiscal year, deliver to Tenant a reasonably detailed statement of the actual amount of Operating Costs for such fiscal year ("**Year End Statement**"). Failure of Landlord to provide the Year End Statement within the time prescribed shall not relieve Tenant from its obligations hereunder. If the total of such monthly remittances on account of any fiscal year is greater than Tenant's Share of Operating Costs actually incurred for such fiscal year, then, provided no Event of Default has occurred nor any event which, with the passage of time and/or the giving of notice would constitute an Event of Default, Tenant may credit the difference against the next installment of additional rent on account of Operating Costs due hereunder, except that if such difference is determined after the end of the Term, Landlord shall refund such difference to Tenant within thirty (30) days after such determination to the extent that such difference exceeds any amounts then due from Tenant to Landlord. If the total of such remittances is less than Tenant's Share of Operating Costs actually incurred for such fiscal year, Tenant shall pay the difference to Landlord, as additional rent hereunder, within ten (10) days of Tenant's receipt of an invoice therefor. Landlord's estimate of Operating Costs for the next fiscal year shall be based upon the Operating Costs actually incurred for the prior fiscal year as reflected in the Year-End Statement plus a reasonable adjustment based upon estimated increases in Operating Costs. The provisions of this Section 5.2(d) shall survive the expiration or earlier termination of this Lease.

(e) **Part Years**. If the Term Commencement Date or the Expiration Date occurs in the middle of a fiscal year, Tenant shall be liable for only that portion of the Operating Costs with respect to such fiscal year within the Term from and after the Term Commencement Date.

(f) **Gross-Up**. If, during any fiscal year, less than 95% of the Building is occupied by tenants or if Landlord was not supplying all tenants with the services being supplied

to Tenant hereunder, actual Operating Costs incurred shall be reasonably extrapolated by Landlord on an item-by-item basis to the reasonable Operating Costs that would have been incurred if the Building was 95% occupied and such services were being supplied to all tenants, and such extrapolated Operating Costs shall, for all purposes hereof, be deemed to be the Operating Costs for such fiscal year. This "gross up" treatment shall be applied only with respect to variable Operating Costs arising from services provided to Common Areas or to space in the Building being occupied by tenants (which services are not provided to vacant space or may be provided only to some tenants) in order to allocate equitably such variable Operating Costs to the tenants receiving the benefits thereof.

(g) **Audit Right**. Provided there is no Event of Default nor any event which, with the passage of time and/or the giving of notice would constitute an Event of Default, Tenant may, upon at least sixty (60) days' prior written notice, inspect or audit Landlord's records relating to Operating Costs for any periods of time within the previous fiscal year before the audit or inspection. However, no audit or inspection shall extend to periods of time before the Rent Commencement Date. If Tenant fails to object to the calculation of Tenant's Share of Operating Costs on the Year-End Statement within sixty (60) days after such statement has been delivered to Tenant and/or fails to complete any such audit or inspection within ninety (90) days after receipt of the Year End Statement, then Tenant shall be deemed to have waived its right to object to the calculation of Tenant's Share of Operating Costs for the year in question and the calculation thereof as set forth on such statement shall be final. Tenant's audit or inspection shall be conducted only at Landlord's offices or the offices of Landlord's property manager during business hours reasonably designated by Landlord. Tenant shall pay the cost of such audit or inspection. Tenant may not conduct an inspection or have an audit performed more than once during any fiscal year. If such inspection or audit reveals that an error was made in the calculation of Tenant's Share of Operating Costs previously charged to Tenant, then, provided there is no Event of Default nor an event which, with the passage of time and/or the giving of notice would constitute an Event of Default, Tenant may credit the difference against the next installment of additional rent on account of Operating Costs due hereunder, except that if such difference is determined after the end of the Term, Landlord shall refund such difference to Tenant within thirty (30) days after such determination to the extent that such difference exceeds any amounts then due from Tenant to Landlord. If such inspection or audit reveals an underpayment by Tenant, then Tenant shall pay to Landlord, as additional rent hereunder, any underpayment of any such costs, as the case may be, within thirty (30) days after receipt of an invoice therefor. Tenant shall maintain the results of any such audit or inspection confidential and shall not be permitted to use any third party to perform such audit or inspection, other than an independent firm of certified public accountants or a commercial real estate audit firm with at least ten (10) years of experience (A) reasonably acceptable to Landlord, (B) which is not compensated on a contingency fee basis or in any other manner which is dependent upon the results of such audit or inspection, and (C) which executes Landlord's standard confidentiality agreement whereby it shall agree to maintain the results of such audit or inspection confidential. The provisions of this Section 5.2(g) shall survive the expiration or earlier termination of this Lease.

5.3 Taxes.

(a) "**Taxes**" shall mean the real estate taxes and other taxes, levies and assessments imposed upon the Unit of the Condominium in which the Building and the Land are

located (the "**Unit**") and upon any personal property of Landlord used in the operation thereof, or on Landlord's interest therein or such personal property; charges, fees and assessments for transit, housing, police, fire or other services or purported benefits to the Building and the Land (including without limitation any community preservation assessments); service or user payments in lieu of taxes; and any and all other taxes, levies, betterments, assessments and charges arising from the ownership, leasing, operation, use or occupancy of the Building and the Land or based upon rentals derived therefrom, which are or shall be imposed by federal, state, county, municipal or other governmental authorities. Taxes shall not include any inheritance, estate, succession, gift, franchise, rental, income or profit tax, capital stock tax, capital levy or excise, or any income taxes arising out of or related to the ownership and operation of the Unit, provided, however, that any of the same and any other tax, excise, fee, levy, charge or assessment, however described, that may in the future be levied or assessed as a substitute for or an addition to, in whole or in part, any tax, levy or assessment which would otherwise constitute Taxes, whether or not now customary or in the contemplation of the parties on the Execution Date of this Lease, shall constitute Taxes, but only to the extent calculated as if the Unit were the only real estate owned by Landlord. "Taxes" shall also include reasonable expenses (including without limitation legal and consultant fees) of tax abatement or other proceedings contesting assessments or levies.

Prior to the fiscal year in which the Unit has been created and assessed (the "**Applicable Fiscal Year**"), Landlord shall allocate Taxes which are incurred with respect to the Common Areas of the Campus on a reasonable basis. From and after substantial completion of any occupiable improvements constructed as part of a Future Development, if such improvements are not separately assessed, Landlord shall reasonably allocate Taxes between the Building and such improvements and the land area associated with the same. From and after the Applicable Fiscal Year, such allocation shall be effected based upon the Taxes payable by Landlord with respect to the unit in the Condominium in which the Property is located.

(b) "**Tax Period**" shall be any fiscal/tax period in respect of which Taxes are due and payable to the appropriate governmental taxing authority (i.e., as mandated by the governmental taxing authority), any portion of which period occurs during the Term of this Lease.

(c) **Payment of Taxes**. Commencing as of the Term Commencement Date and continuing thereafter throughout the remainder of the Term of the Lease, Tenant shall pay to Landlord, as additional rent, Tenant's Share of Taxes. Landlord may make a good faith estimate of the Taxes to be due by Tenant for any Tax Period or part thereof during the Term, and Tenant shall pay to Landlord, on the Term Commencement Date and on the first (1st) day of each calendar month thereafter, an amount equal to Tenant's Share of Taxes for such Tax Period or part thereof divided by the number of months therein. Landlord may estimate and re-estimate Tenant's Share of Taxes and deliver a copy of the estimate or re-estimate to Tenant. Thereafter, the monthly installments of Tenant's Share of Taxes shall be appropriately adjusted in accordance with the estimations so that, by the end of the Tax Period in question, Tenant shall have paid all of Tenant's Share of Taxes as estimated by Landlord. Any amounts paid based on such an estimate shall be subject to adjustment as herein provided when actual Taxes are available for each Tax Period. If the total of such monthly remittances is greater than Tenant's Share of Taxes actually due for such Tax Period, then, provided no Event of Default has occurred nor any event which, with the passage of time and/or the giving of notice would constitute an Event of Default, Tenant may credit the difference against the next installment of additional rent on account of Taxes due hereunder, except

that if such difference is determined after the end of the Term, Landlord shall refund such difference to Tenant within thirty (30) days after such determination to the extent that such difference exceeds any amounts then due from Tenant to Landlord. If the total of such remittances is less than Tenant's Share of Taxes actually due for such Tax Period, Tenant shall pay the difference to Landlord, as additional rent hereunder, within ten (10) days of Tenant's receipt of an invoice therefor. Landlord's estimate for the next Tax Period shall be based upon actual Taxes for the prior Tax Period plus a reasonable adjustment based upon estimated increases in Taxes. The provisions of this Section 5.3(c) shall survive the expiration or earlier termination of this Lease.

(d) **Effect of Abatements**. Appropriate credit against Taxes shall be given for any refund obtained by reason of a reduction in any Taxes by the assessors or the administrative, judicial or other governmental agency responsible therefor after deduction of Landlord's expenditures for reasonable legal fees and for other reasonable expenses incurred in obtaining the Tax refund.

(e) **Part Years**. If the Term Commencement Date or the Expiration Date occurs in the middle of a Tax Period, Tenant shall be liable for only that portion of the Taxes, as the case may be, with respect to such Tax Period within the Term from and after the Term Commencement Date.

5.4 Late Payments.

(a) Any payment of Rent due hereunder not paid when due shall bear interest for each month or fraction thereof from the due date until paid in full at the annual rate of twelve percent (12%), or at any applicable lesser maximum legally permissible rate for debts of this nature (the "**Default Rate**").

(b) Additionally, if Tenant fails to make any payment within five (5) days after the due date therefor, Landlord may charge Tenant a fee, which shall constitute liquidated damages, equal to three (3%) of any such late payment; provided, however, Landlord shall waive the late fee once in any twelve-(12)-month period in the event Tenant shall pay such late payment within five
(5) days following Landlord's written notice to Tenant of the occurrence of such late payment.

(c) For each Tenant payment check to Landlord that is returned by a bank for any reason, Tenant shall pay a returned check charge equal to the amount as shall be customarily charged by Landlord's bank at the time.

(d) Money paid by Tenant to Landlord shall be applied to Tenant's account in the following order: first, to any unpaid additional rent, including without limitation late charges, returned check charges, legal fees and/or court costs chargeable to Tenant hereunder; and then to unpaid Base Rent.

(e) The parties agree that the late charge referenced in Section 5.4(b) represents a fair and reasonable estimate of the costs that Landlord will incur by reason of any late payment by Tenant, and the payment of late charges and interest are distinct and separate in that the payment of interest is to compensate Landlord for the use of Landlord's money by Tenant, while the payment

of late charges is to compensate Landlord for Landlord’s processing, administrative and other costs incurred by Landlord as a result of Tenant’s delinquent payments. Acceptance of a late

charge or interest shall not constitute a waiver of Tenant's default with respect to the overdue amount or prevent Landlord from exercising any of the other rights and remedies available to Landlord under this Lease or at law or in equity now or hereafter in effect.

(f) If Tenant during any six (6) month period shall be more than five (5) business days delinquent in the payment of any installment of Rent on three (3) or more occasions, then, notwithstanding anything herein to the contrary, Landlord may, by written notice to Tenant, elect to require Tenant to pay all Base Rent and additional rent on account of Operating Costs and Taxes quarterly in advance. Such right shall be in addition to and not in lieu of any other right or remedy available to Landlord hereunder or at law on account of Tenant's default hereunder.

5.5 No Offset; Independent Covenants; Waiver. Rent shall be paid without notice or demand, and without setoff, counterclaim, defense, abatement, suspension, deferment, reduction or deduction, except as expressly provided herein. **TENANT WAIVES ALL RIGHTS (I) TO ANY ABATEMENT, SUSPENSION, DEFERMENT, REDUCTION OR DEDUCTION OF OR FROM RENT, AND (II) TO QUIT, TERMINATE OR SURRENDER THIS LEASE OR THE PREMISES OR ANY PART THEREOF, EXCEPT AS EXPRESSLY PROVIDED HEREIN. TENANT HEREBY ACKNOWLEDGES AND AGREES THAT THE OBLIGATIONS OF TENANT HEREUNDER SHALL BE SEPARATE AND INDEPENDENT COVENANTS AND AGREEMENTS, THAT RENT SHALL CONTINUE TO BE PAYABLE IN ALL EVENTS AND THAT THE OBLIGATIONS OF TENANT HEREUNDER SHALL CONTINUE UNAFFECTED, UNLESS THE REQUIREMENT TO PAY OR PERFORM THE SAME SHALL HAVE BEEN TERMINATED PURSUANT TO AN EXPRESS PROVISION OF THIS LEASE. LANDLORD AND TENANT EACH ACKNOWLEDGES AND AGREES THAT THE INDEPENDENT NATURE OF THE OBLIGATIONS OF TENANT HEREUNDER REPRESENTS FAIR, REASONABLE, AND ACCEPTED COMMERCIAL PRACTICE WITH RESPECT TO THE TYPE OF PROPERTY SUBJECT TO THIS LEASE, AND THAT THIS AGREEMENT IS THE PRODUCT OF FREE AND INFORMED NEGOTIATION DURING WHICH BOTH LANDLORD AND TENANT WERE REPRESENTED BY COUNSEL SKILLED IN NEGOTIATING AND DRAFTING COMMERCIAL LEASES IN MASSACHUSETTS, AND THAT THE ACKNOWLEDGEMENTS AND AGREEMENTS CONTAINED HEREIN ARE MADE WITH FULL KNOWLEDGE OF THE HOLDING IN WESSON V. LEONE ENTERPRISES, INC., 437 MASS. 708 (2002). SUCH ACKNOWLEDGEMENTS, AGREEMENTS AND WAIVERS BY TENANT ARE A MATERIAL INDUCEMENT TO LANDLORD ENTERING INTO THIS LEASE.**

5.6 Survival. Any obligations under this Section 5 which shall not have been paid at the expiration or earlier termination of the Term shall survive such expiration or earlier termination and shall be paid when and as the amount of same shall be determined and be due.

6. INTENTIONALLY DELETED.

7. LETTER OF CREDIT

7.1 Amount. Contemporaneously with the execution of this Lease, Tenant shall deliver to Landlord either (i) cash in the amount specified in the Lease Summary Sheet (the "**Cash**

Security Deposit"), which shall be held by Landlord in accordance with Section 7.5 below, or (ii) an irrevocable letter of credit (the "**Letter of Credit**") that shall (a) be in the initial amount of
$1,519,282.90; (b) be issued in substantially the form attached hereto as Exhibit 6; (c) name Landlord as its beneficiary; (d) be drawn on an FDIC insured financial institution reasonably satisfactory to Landlord that both (x) either has an office in the greater Boston metropolitan area that will accept presentation of, and pay against, the Letter of Credit or will permit drawings by facsimile or overnight courier, and (y) satisfies both the Minimum Rating Agency Threshold and the Minimum Capital Threshold (as those terms are defined below). The "**Minimum Rating Agency Threshold**" shall mean that the issuing bank has outstanding unsecured, uninsured and unguaranteed senior long-term indebtedness that is then rated (without regard to qualification of such rating by symbols such as "+" or "-" or numerical notation) "Baa" or better by Moody's Investors Service, Inc. and/or "BBB" or better by Standard & Poor's Rating Services, or a comparable rating by a comparable national rating agency designated by Landlord in its discretion. The "**Minimum Capital Threshold**" shall mean that the Issuing Bank has combined capital, surplus and undivided profits of not less than $10,000,000,000. Notwithstanding the foregoing, Landlord hereby agrees that, as of the Execution Date, Silicon Valley Bank, N.A. is an Approved Issuer. The Letter of Credit (and any renewals or replacements thereof) shall be for a term of not less than one (1) year. If the issuer of the Letter of Credit gives notice of its election not to renew such Letter of Credit for any additional period, Tenant shall be required to deliver a substitute Letter of Credit satisfying the conditions hereof at least thirty (30) days prior to the expiration of the term of such Letter of Credit. If the issuer of the Letter of Credit fails to satisfy either or both of the Minimum Rating Agency Threshold or the Minimum Capital Threshold, Tenant shall be required to deliver a substitute letter of credit from another issuer reasonably satisfactory to the Landlord and that satisfies both the Minimum Rating Agency Threshold and the Minimum Capital Threshold not later than ten (10) Business Days after Landlord notifies Tenant of such failure. Tenant agrees that it shall from time to time, as necessary, whether as a result of a draw on the Letter of Credit by Landlord pursuant to the terms hereof or as a result of the expiration of the Letter of Credit then in effect, renew or replace the original and any subsequent Letter of Credit so that a Letter of Credit, in the amount required hereunder, is in effect until a date which is at least sixty (60) days after the Expiration Date. If Tenant fails to furnish such renewal or replacement at least sixty (60) days prior to the stated expiration date of the Letter of Credit then held by Landlord, Landlord may draw upon such Letter of Credit and hold the proceeds thereof (and such proceeds need not be segregated) as a Security Deposit pursuant to the terms of this Article 7. Any renewal or replacement of the original or any subsequent Letter of Credit shall meet the requirements for the original Letter of Credit as set forth above, except that such replacement or renewal shall be issued by a national bank reasonably satisfactory to Landlord at the time of the issuance thereof.

7.2 Application of Proceeds of Letter of Credit. Upon an Event of Default, or if any proceeding shall be instituted by or against Tenant pursuant to any of the provisions of any Act of Congress or State law relating to bankruptcy, reorganizations, arrangements, compositions or other relief from creditors (and, in the case of any proceeding instituted against it, if Tenant shall fail to have such proceedings dismissed within ninety (90) days) or if Tenant is adjudged bankrupt or insolvent as a result of any such proceeding, Landlord at its sole option may draw down all or a part of the Letter of Credit. The balance of any Letter of Credit cash proceeds shall be held in accordance with Section 7.5 below. Should the entire Letter of Credit, or any portion thereof, be drawn down by Landlord, Tenant shall, upon the written demand of Landlord, deliver a replacement Letter of Credit in the amount drawn, and Tenant's failure to do so within ten (10)

days after receipt of such written demand shall constitute an additional Event of Default hereunder. The application of all or any part of the cash proceeds of the Letter of Credit to any obligation or default of Tenant under this Lease shall not deprive Landlord of any other rights or remedies Landlord may have nor shall such application by Landlord constitute a waiver by Landlord.

7.3 Transfer of Letter of Credit. In the event that Landlord transfers its interest in the Premises, Tenant shall upon notice from and at no cost to Landlord, deliver to Landlord an amendment to the Letter of Credit or a replacement Letter of Credit naming Landlord's successor as the beneficiary thereof. If Tenant fails to deliver such amendment or replacement within ten (10) days after written notice from Landlord, Landlord shall have the right to draw down the entire amount of the Letter of Credit and hold the proceeds thereof in accordance with Section 7.5 below.

7.4 Cash Proceeds of Letter of Credit. Landlord shall hold the Cash Security Deposit and/or the balance of proceeds remaining after a draw on the Letter of Credit (each hereinafter referred to as the "**Security Deposit**") as security for Tenant's performance of all its Lease obligations. After an Event of Default, Landlord may apply the Security Deposit, or any part thereof, to Landlord's damages without prejudice to any other Landlord remedy. Landlord has no obligation to pay interest on the Security Deposit and may co-mingle the Security Deposit with Landlord's funds. If Landlord conveys its interest under this Lease, the Security Deposit, or any part not applied previously, may be turned over to the grantee in which case Tenant shall look solely to the grantee for the proper application and return of the Security Deposit.

7.5 Return of Security Deposit or Letter of Credit. Should Tenant comply with all of such terms, covenants and conditions and promptly pay all sums payable by Tenant to Landlord hereunder, the Security Deposit and/or Letter of Credit or the remaining proceeds therefrom, as applicable, shall be returned to Tenant within sixty (60) days after the end of the Term, less any portion thereof which may have been utilized by Landlord to cure any default or applied to any actual damage suffered by Landlord.

8. INTENTIONALLY OMITTED.

9. UTILITIES, LANDLORD'S SERVICES

9.1 Electricity. Landlord shall contract with the utility provider for electric service to the Property, including the Premises. Commencing on the Term Commencement Date, Tenant shall pay all charges for electricity furnished to the Premises and any equipment exclusively serving the Premises, as additional rent, as measured by a submeter, with such metering equipment to be installed as part of Landlord's Work. At Tenant's request, Landlord shall provide Tenant with reasonable back-up documentation regarding the total charges and the method of allocating the charges to Tenant. Tenant shall, at Tenant's sole cost and expense, maintain and keep in good order, condition and repair the metering equipment used to measure electricity furnished to the Premises and any equipment exclusively serving the same. Tenant shall not exceed its allotted base building capacities defined on Exhibit 5 attached hereto.

9.2 Water. Landlord shall contract with the utility provider for water service to the Property, including the Premises. Except as otherwise provided below, the cost of providing water service to the Premises and all other portions of the Building (including, without limitation, the

premises of other tenants or occupants of the Building) shall be included in Operating Costs. Notwithstanding the foregoing, if Landlord determines that Tenant is using water in excess of its proportionate share (by floor area) of the total water usage in the Building, Landlord may elect, at Tenant's expense, to furnish and install in a location in or near the Premises metering equipment to measure water furnished to the Premises and any equipment exclusively serving the same. In such event, Tenant shall, within thirty (30) days after Landlord's written demand therefor from time to time, pay to Landlord, as additional rent, the full amount of any water service charges attributable to such meter.

9.3 Gas. Landlord shall contract with the utility provider for gas service to the Property, including the Premises. The cost of gas used to serve base building plumbing, mechanical and electrical systems shall be included in the costs reimbursed by Tenant pursuant to Section 9.6 below. If Tenant requires gas service for the operation of Tenant's laboratory equipment in the Premises, Tenant shall pay all charges for gas furnished to the Premises and/or any equipment exclusively serving the Premises as additional rent, based, at Landlord's election,
(i) on Landlord's reasonable estimate of such gas usage or (ii) on metering or submetering equipment installed by Landlord at Tenant's expense.

9.4 Other Utilities. Subject to Landlord's reasonable rules and regulations governing the same, Tenant shall obtain and pay, as and when due, for all other utilities and services consumed in and/or furnished to the Premises, together with all taxes, penalties, surcharges and maintenance charges pertaining thereto. Tenant shall be responsible for all telephone and data wiring throughout its Premises.

9.5 Interruption or Curtailment of Utilities. When necessary by reason of accident or emergency, or for repairs, alterations, replacements or improvements which in the reasonable judgment of Landlord are desirable or necessary to be made, Landlord reserves the right, upon as much prior notice to Tenant as is practicable under the circumstances and no less than twenty-four
(24) hours' notice except in the event of an emergency, to interrupt, curtail, or stop (i) the furnishing of hot and/or cold water, and (ii) the operation of the plumbing and electric systems. Landlord shall diligently exercise commercially reasonable efforts to reduce the duration of and eliminate the cause of any such interruption, curtailment, stoppage or suspension, but there shall be no diminution or abatement of Rent or other compensation due from Landlord to Tenant hereunder, nor shall this Lease be affected or any of Tenant's obligations hereunder reduced, and Landlord shall have no responsibility or liability for any such interruption, curtailment, stoppage, or suspension of services or systems. Notwithstanding the foregoing, (i) in the event any of the utilities serving the Property and the Premises are interrupted and unavailable for more than thirty
(30) continuous calendar days, Tenant shall, at Tenant's option, have the ability to suspend the payment of Rent until all such utilities are again fully serving the Property and the Premises, and
(ii) in the event that any such interruption and unavailability continues for more than sixty (60) continuous calendar days, Tenant shall, at Tenant's option, have the right to terminate this Lease by giving Landlord written notice of Tenant's election to terminate at any time after the expiration of such sixty-day period and before all such utilities are again fully serving the Property and the Premises.

9.6 Landlord's Services. Subject to reimbursement pursuant to Section 5.2 above, and subject to Tenant's allotted base building capacities defined on Exhibit 5 as aforesaid,

Landlord shall provide the services described in Exhibit 7 attached hereto and made a part hereof ("**Landlord's Services**"). All documented costs incurred by Landlord to provide HVAC service to the Premises and not included in Operating Costs shall be reimbursed by Tenant to Landlord as additional rent. Except for the foregoing, and except for the cost of providing and maintaining supplemental HVAC equipment exclusively serving the Premises (which shall be Tenant's responsibility), all costs incurred in connection with the provision of Landlord's Services shall be included in Operating Costs to the extent allowable pursuant to Section 5.2.

10. MAINTENANCE AND REPAIRS

10.1 Maintenance and Repairs by Tenant. Tenant shall keep neat and clean and free of insects, rodents, vermin and other pests and in good repair, order and condition (reasonable wear and tear and damage by Casualty excepted): the Premises, including without limitation the entire interior of the Premises, all electronic, phone and data cabling and related equipment (other than building service equipment) that is installed by or for the exclusive benefit of the Tenant (whether located in the Premises or other portions of the Building), all fixtures, equipment and specialty lighting therein, any supplemental HVAC and humidification equipment exclusively serving the Premises, electrical equipment wiring, doors, non-structural walls, windows and floor coverings, and all laboratory specific systems and equipment that exclusively serve the Premises, including, without limitation, equipment critical to laboratory operations. Without limiting the foregoing, Tenant agrees that it shall maintain in the same repair, order, and condition as on the Term Commencement Date (reasonable wear and tear and damage by Casualty excepted) any equipment which is the responsibility for Tenant to maintain as set forth in this Lease.

10.2 Maintenance and Repairs by Landlord. Except as otherwise provided in Section 15, and subject to Tenant's obligations in Section 10.1 above, Landlord shall maintain and keep in reasonable condition the Building foundation, the roof, Building structure, structural floor slabs and columns in good repair, order and condition. In addition, Landlord shall operate and maintain the Common Areas in substantially the same manner as comparable combination office and laboratory facilities in the vicinity of the Premises. All costs incurred by Landlord under this Section 10.2 shall be included in Operating Costs as provided in Section 5.2.

10.3 Accidents to Sanitary and Other Systems. Tenant shall give to Landlord prompt notice of any fire or accident in the Premises or in the Building and of any damage to, or defective condition in, any part or appurtenance of the Building including, without limitation, sanitary, electrical, ventilation, heating and air conditioning or other systems located in, or passing through, the Premises. Except as otherwise provided in Section 15, and subject to Tenant's obligations in Section 10.1 above, such damage or defective condition shall be remedied by Landlord with reasonable diligence, but, subject to Section 14.5 below, if such damage or defective condition was caused by any of the Tenant Parties, the cost to remedy the same shall be paid by Tenant.

10.4 Floor Load--Heavy Equipment. Tenant shall not place a load upon any floor of the Premises exceeding the floor load per square foot of area which such floor was designed to carry and which is allowed by Legal Requirements. The floor load capacity of the Premises is 100 pounds per square foot, with the exception of certain areas near the vicinity of the western façade of the Building, where the floor load capacity is 50 pounds per square foot. Landlord reserves the right to prescribe the weight and position of all safes, heavy machinery, heavy equipment, freight,

bulky matter or fixtures (collectively, "**Heavy Equipment**"), which shall be placed so as to distribute the weight. Tenant shall notify Landlord of the proposed locations of any Heavy Equipment prior to its installation in the Premises. Heavy Equipment shall be placed and maintained by Tenant at Tenant's expense in settings sufficient in Landlord's reasonable judgment to absorb and prevent vibration, noise and annoyance. Tenant shall not move any Heavy Equipment into or out of the Building without giving Landlord prior written notice thereof and observing all of Landlord's Rules and Regulations with respect to the same. If such Heavy Equipment requires special handling, Tenant agrees to employ only persons holding a Master Rigger's License to do said work, and that all work in connection therewith shall comply with Legal Requirements. Any such moving shall be at the sole risk and hazard of Tenant and Tenant will defend, indemnify and save Landlord and Landlord's agents (including without limitation its property manager), contractors and employees (collectively with Landlord, the "**Landlord Parties**") harmless from and against any and all claims, damages, losses, penalties, costs, expenses and fees (including without limitation reasonable legal fees) (collectively, "**Claims**") resulting directly or indirectly from such moving. Proper placement of all Heavy Equipment in the Premises shall be Tenant's responsibility.

10.5 Premises Cleaning. Tenant shall be responsible, at its sole cost and expense, for janitorial and trash removal services and other biohazard disposal services for the Premises, including any laboratory areas thereof. Such services shall be performed by licensed (where required by law or governmental regulation), insured and qualified contractors approved in advance, in writing, by Landlord (which approval shall not be unreasonably withheld, delayed or conditioned) and on a sufficient basis to ensure that the Premises are at all times kept neat and clean. Landlord shall provide a dumpster and/or compactor at the Building loading dock for Tenant's disposal of non-hazardous and non-controlled substances. All costs incurred by Landlord in connection with such dumpster and/or compactor shall be included in Operating Costs as provided in Section 5.2.

10.6 Pest Control. Tenant, at Tenant's sole cost and expense, shall cause the Premises to be exterminated on a quarterly basis (or more frequently if Landlord reasonably determines the same to be necessary) to Landlord's reasonable satisfaction and shall cause all portions of the Premises used for the storage, preparation, service or consumption of food or beverages to be cleaned daily in a manner reasonably satisfactory to Landlord, and to be treated as necessary against infestation by insects, rodents and other vermin and pests whenever there is evidence of any infestation. Tenant shall not permit any person to enter the Premises for the purpose of providing such extermination services, unless such persons have been reasonably approved by Landlord. If requested by Landlord, Tenant shall, at Tenant's sole cost and expense, store any refuse generated in the Premises by the consumption of food or beverages in a cold box or similar facility.

10.7 Service Interruptions.

(a) Abatement of Rent. In the event that: (i) there shall be an interruption, curtailment or suspension of any service or failure to perform any obligation required to be provided or performed by Landlord pursuant to Sections 9 and/or 10 (and no reasonably equivalent alternative service or supply is provided by Landlord) that shall materially interfere with Tenant's use and enjoyment of the Premises, or any portion thereof (any such event, a "**Service**

Interruption"), and (ii) such Service Interruption shall continue for five (5) consecutive business days following receipt by Landlord of written notice (the "**Service Interruption Notice**") from Tenant describing such Service Interruption ("**Abatement Service Interruption Cure Period**"), and (iii) such Service Interruption shall not have been caused by an act or omission of Tenant or Tenant's agents, employees, contractors or invitees (an event that satisfies the foregoing conditions (i)-(iii) being referred to hereinafter as a "**Material Service Interruption**") then, Tenant, subject to the next following sentence, shall be entitled to an equitable abatement of Base Rent, Operating Costs and Taxes based on the nature and duration of the Material Service Interruption and the area of the Premises affected, for any and all days following the Material Service Interruption Cure Period that both (x) the Material Service Interruption is continuing and (y) Tenant does not use such affected areas of the Premises for a bona fide business purpose. Any efforts by Tenant to respond or react to any Material Service Interruption, including, without limitation, any activities by Tenant to remove its personal property from the affected areas of the Premises, shall not constitute a use that precludes abatement pursuant to this Section 10.7(a). The Abatement Service Interruption Cure Period shall be extended by reason of any delays in Landlord's ability to cure the Service Interruption in question caused by Landlord's Force Majeure, provided however, that in no event shall the extension of the Abatement Service Interruption Cure Period with respect to any Service Interruption be longer than fifteen (15) consecutive business days after Landlord receives the applicable Service Interruption Notice.

(b) The provisions of this Section 10.7 shall not apply in the event of a Service Interruption caused by Casualty or Taking (see Section 15 hereof).

(c) The provisions of this Section 10.7 set forth Tenant's sole rights and remedies, both in law and in equity, in the event of any Service Interruption.

11. ALTERATIONS AND IMPROVEMENTS BY TENANT

11.1 Landlord's Consent Required.

(a) Tenant shall not make any alterations, decorations, installations, removals, additions or improvements (collectively "**Alterations**") in or to the Premises without Landlord's prior written approval of the contractor(s), written plans and specifications and a time schedule therefor. Landlord reserves the right to require that Tenant use Landlord's preferred vendor(s) (and Landlord agrees to provide at least two (2) preferred vendors for any project) for any Alterations that involve roof penetrations, alarm tie-ins, sprinklers, fire alarm and other life safety equipment. Tenant shall not make any amendments or additions to plans and specifications approved by Landlord without Landlord's prior written consent. Landlord's approval of non-structural Alterations shall not be unreasonably withheld, conditioned or delayed. Notwithstanding the foregoing, Landlord may withhold its consent in its sole discretion (i) to any Alteration to or affecting the roof and/or building systems, (ii) with respect to matters of aesthetics relating to Alterations to or affecting the exterior of the Building, and (iii) to any Alteration affecting the Building structure. Tenant shall be responsible for all elements of the design of Tenant's plans (including, without limitation, compliance with Legal Requirements, functionality of design, the structural integrity of the design, the configuration of the Premises and the placement of Tenant's furniture, appliances and equipment), and Landlord's approval of Tenant's plans shall in no event relieve Tenant of the responsibility for such design. In seeking Landlord's approval, Tenant shall

provide Landlord, at least fourteen (14) business days in advance of any proposed construction, with plans, specifications, bid proposals, certified stamped engineering drawings and calculations by Tenant's engineer of record or architect of record, (including connections to the Building's structural system, modifications to the Building's envelope, non-structural penetrations in slabs or walls, and modifications or tie-ins to life safety systems), work contracts, requests for laydown areas and such other information concerning the nature and cost of the alterations as Landlord may reasonably request. Landlord shall have no liability or responsibility for any claim, injury or damage alleged to have been caused by the particular materials (whether building standard or non- building standard), appliances or equipment selected by Tenant in connection with any work performed by or on behalf of Tenant. Except as otherwise expressly set forth herein, all Alterations shall be done at Tenant's sole cost and expense and at such times and in such manner as Landlord may from time to time reasonably designate. If Tenant shall make any Alterations, then Landlord may elect to require Tenant at the expiration or sooner termination of the Term to restore the Premises to substantially the same condition as existed immediately prior to the Alterations provided that such election shall be made at the time Landlord gives its approval for such Alterations, provided further Landlord will not elect to require Tenant to remove any Alterations unless the same, in Landlord's reasonable judgment, (i) adversely affect the general utility of the Building for use by prospective future tenants and/or (ii) required unusual expense to readapt the Premises to normal use as a biotechnology office and research and development facility. Landlord agrees that Tenant shall have no obligation to remove any customary office/non-laboratory Alterations to the Premises. Tenant shall provide Landlord with reproducible record drawings (in CAD format) of all Alterations within sixty (60) days after completion thereof.

(b) **Alterations Permitted without Landlord's Consent**. Notwithstanding the provisions of Section 11.1(a), the Alterations which (x) consist solely of decorative or cosmetic work that does not affect or involve the Building's structure or base systems, and (y) which do not cost in excess of Seventy-Five Thousand Dollars ($75,000.00), shall not be subject to Landlord's prior approval provided that Tenant delivers a reasonable description of such Alterations to Landlord at least five (5) business days' prior to commencing such work and subject to the remaining provisions of this Section 11.

11.2 After-Hours. Landlord and Tenant recognize that to the extent Tenant elects to perform some or all of the Alterations during times other than normal construction hours (i.e., Monday-Friday, 7:00 a.m. to 3:00 p.m., excluding holidays), Landlord may need to make arrangements to have supervisory personnel on site. Accordingly, Landlord and Tenant agree as follows: Tenant shall give Landlord at least two (2) business days' prior written notice of any time outside of normal construction hours when Tenant intends to perform any Alterations (the "**After- Hours Work**"). Tenant shall reimburse Landlord, within ten (10) days after demand therefor, for the cost of Landlord's supervisory personnel overseeing the After-Hours Work. In addition, if construction during normal construction hours unreasonably disturbs other tenants of the Building, in Landlord's sole discretion, Landlord may require Tenant to stop the performance of Alterations during normal construction hours and to perform the same after hours, subject to the foregoing requirement to pay for the cost of Landlord's supervisory personnel.

11.3 Harmonious Relations. Tenant agrees to conduct its labor relations and its relations with its employees in such manner as to avoid all strikes, picketing and boycotts of, on or about the Premises or the Building. Tenant further agrees that if any of its employees strike or

if a picket line or boycott is established or conducted or carried out on or about the Property against Tenant or its contractors or employees, or any of them, Tenant will forthwith cease those operations in and upon the Premises that have caused the same until all disputes are settled.

11.4 Liens. No Alterations shall be undertaken by Tenant until (i) Tenant has made provision for written waiver of liens from all contractors for such Alteration and taken other appropriate protective measures approved and/or required by Landlord; and (ii) Tenant has procured appropriate surety payment and performance bonds which shall name Landlord as an additional obligee and has filed lien bond(s) (in jurisdictions where available) on behalf of such contractors. Any mechanic's lien filed against the Premises or the Building for work claimed to have been done for, or materials claimed to have been furnished to, Tenant shall be discharged by Tenant within ten (10) days thereafter, at Tenant's expense by filing the bond required by law or otherwise.

11.5 General Requirements. Unless Landlord and Tenant otherwise agree in writing, Tenant shall (a) procure or cause others to procure on its behalf all necessary permits before undertaking any Alterations in the Premises (and provide copies thereof to Landlord); (b) perform all of such Alterations in a good and workmanlike manner, employing materials of good quality and in compliance with Landlord's construction rules and regulations, all insurance requirements of this Lease, and Legal Requirements; and (c) defend, indemnify and hold the Landlord Parties harmless from and against any and all Claims occasioned by or growing out of such Alterations.

12. SIGNAGE

12.1 Restrictions. Tenant shall have the right, at Tenant's expense, to install Building standard signage identifying Tenant's business at the entrance to the Premises, which signage shall be subject to Landlord's prior written consent (which consent shall not be unreasonably withheld, conditioned or delayed). Subject to the foregoing, and subject to Section 12.2 below, Tenant shall not place or suffer to be placed or maintained on the exterior of the Premises, or any part of the interior visible from the exterior thereof, any sign, banner, advertising matter or any other thing of any kind (including, without limitation, any hand-lettered advertising), and shall not place or maintain any decoration, letter or advertising matter on the glass of any window or door of the Premises without first obtaining Landlord's written approval. No signs or blinds may be put on or in any window or elsewhere if visible from the exterior of the Building, provided that Tenant shall be permitted to install Building standard blinds in the Premises.

12.2 Exterior Signage.

(a) Monument Signage. Subject to the provisions of this Section 12.2, for so long as: (x) there is no Event of Default of Tenant and (y) the Lease is in full force and effect (the "**Monument Signage Condition**"), then Tenant shall have the right to require Landlord to list, at Landlord's initial cost and expense, Tenant's name ("**Tenant's Monument Signage**") on each of the two (2) exterior monument signs to be constructed by Landlord on the Property. Such monument signs shall each be a common monument (i.e. other tenant(s) in the Building may have identification signage installed on such monuments). The right to the Tenant's Monument Signage granted pursuant to this Section 12.2 is personal to Tenant, and may not be exercised by any occupant, subtenant, or other assignee of Tenant, other than an Affiliated Entity or Successor (the

parties hereby agreeing that Tenant shall be responsible for the cost of any change in Tenant's Monument Signage). The parties hereby agree that the maintenance and removal of such Tenant's Monument Signage (including, without limitation, the repair and cleaning of the existing monument façade upon removal of Tenant's Monument Signage) shall be performed at Landlord's sole cost and expense, except that Tenant shall be responsible for the cost of any change in Tenant's Monument Signage during the initial Term of the lease.

12.3 Building Directory.

Landlord shall list Tenant within the directory in the Building lobby at Landlord's sole cost and expense.

13. ASSIGNMENT, MORTGAGING AND SUBLETTING

13.1 Landlord's Consent Required. Tenant shall not mortgage or encumber this Lease in whole or in part whether at one time or at intervals, operation of law or otherwise. Except as expressly otherwise set forth herein Tenant shall not, without Landlord's prior written consent, assign, sublet, license or transfer this Lease or the Premises in whole or in part whether by changes in 50% or more of the ownership or control of Tenant, or any direct or indirect owner of Tenant, whether at one time or at intervals, by sale or transfer of stock, partnership or beneficial interests, operation of law or otherwise, or permit the occupancy of all or any portion of the Premises by any person or entity other than Tenant's employees (each of the foregoing, a "**Transfer**"). Any purported Transfer made without Landlord's consent, if required hereunder, shall be void and confer no rights upon any third person, provided that if there is a Transfer, Landlord may collect rent from the transferee without waiving the prohibition against Transfers, accepting the transferee, or releasing Tenant from full performance under this Lease. In the event of any Transfer in violation of this Section 13, Landlord shall have the right to terminate this Lease upon thirty (30) days' written notice to Tenant given within sixty (60) days after receipt of written notice from Tenant to Landlord of any Transfer, or within sixty (60) days after Landlord first learns of the Transfer if no notice is given. No Transfer shall relieve Tenant of its primary obligation as party Tenant hereunder, nor shall it reduce or increase Landlord's obligations under this Lease. Notwithstanding the foregoing, so long as Tenant's stock is traded on a public exchange, the sale or transfer of such stock shall not be deemed a Transfer.

13.2 Landlord's Recapture Right.

(a) Subject to Section 13.7 below, Tenant shall, prior to offering or advertising the Premises or any portion thereof for assignment or sublease, give a written notice (the "**Recapture Notice**") to Landlord which: (i) states that Tenant desires to make a Transfer, (ii) identifies the affected portion of the Premises (the "**Recapture Premises**"), (iii) in the case of a sublease identifies the period of time (the "**Recapture Period**") during which Tenant proposes to sublet the Recapture Premises, or indicates that Tenant proposes to assign its interest in this Lease, and (iv) offers to Landlord to terminate this Lease with respect to the Recapture Premises (in the case of a proposed assignment of Tenant's interest in this Lease or a subletting for the remainder of the term of this Lease) or to suspend the Term for the Recapture Period (i.e. the Term with respect to the Recapture Premises shall be terminated during the Recapture Period and Tenant's rental obligations shall be proportionately reduced). Landlord shall have fifteen (15) business days

within which to respond to the Recapture Notice. Notwithstanding the foregoing, within the first three (3) years after the Term Commencement Date, Tenant shall not be required to deliver a Recapture Notice to Landlord prior to offering or advertising a portion of the Premises constituting less than fifty percent (50%) of the Premises for sublease.

(b) Notwithstanding anything to the contrary contained herein, if Landlord notifies Tenant that it accepts the offer contained in the Recapture Notice or any subsequent Recapture Notice, Tenant shall have the right, for a period of fifteen (15) days following receipt of such notice from Landlord, *time being of the essence*, to notify Landlord in writing that it wishes to withdraw such offer and this Lease shall continue in full force and effect.

13.3 Standard of Consent to Transfer. If Landlord does not timely give written notice to Tenant accepting a Recapture Offer or declines to accept the same (or in the case of a sublease for which Tenant is not required to deliver a Recapture Notice, as set forth in Section 13.2(a) above), then Landlord agrees that, subject to the provisions of this Section 13, Landlord shall not unreasonably withhold, condition or delay its consent to a Transfer on the terms contained in the Recapture Notice to an entity which will use the Premises for the Permitted Uses and, in Landlord's reasonable opinion: (a) has a tangible net worth and other financial indicators sufficient to meet the Transferee's obligations under the Transfer instrument in question; (b) has a business reputation compatible with the operation of a first-class combination laboratory, research, development and office building; and (c) the intended use of such entity does not violate any restrictive use provisions then in effect with respect to space in the Building.

13.4 Listing Confers no Rights. The listing of any name other than that of Tenant, whether on the doors of the Premises or on the Building directory, or otherwise, shall not operate to vest in any such other person, firm or corporation any right or interest in this Lease or in the Premises or be deemed to effect or evidence any consent of Landlord, it being expressly understood that any such listing is a privilege extended by Landlord revocable at will by written notice to Tenant.

13.5 Profits In Connection with Transfers. Tenant shall, within thirty (30) days of receipt thereof, pay to Landlord fifty percent (50%) of any rent, sum or other consideration to be paid or given in connection with any Transfer, either initially or over time, after deducting reasonable actual out-of-pocket legal, and brokerage expenses incurred by Tenant and unamortized improvements paid for by Tenant in connection therewith, in excess of Rent hereunder as if such amount were originally called for by the terms of this Lease as additional rent.

13.6 Prohibited Transfers. Notwithstanding any contrary provision of this Lease, Tenant shall have no right to make a Transfer unless on both (i) the date on which Tenant notifies Landlord of its intention to enter into a Transfer and (ii) the date on which such Transfer is to take effect, Tenant is not in default of any of its obligations under this Lease. Notwithstanding anything to the contrary contained herein, Tenant agrees that in no event shall Tenant make a Transfer to (a) any government agency; (b) any tenant, subtenant or occupant of other space in the Building provided that Landlord has, or will within six (6) months after the date of Tenant's Recapture Notice have, comparable space available in the Building or in another building on the Campus; or
(c) any entity with whom Landlord shall have negotiated for space in the Property in the six (6) months immediately preceding such proposed Transfer.

13.7 Exceptions to Requirement for Consent. Notwithstanding anything to the contrary herein contained, Tenant shall have the right, without obtaining Landlord's consent and without giving Landlord a Recapture Notice, to make a Transfer to (a) an Affiliated Entity (hereinafter defined) so long as such entity remains in such relationship to Tenant, and (b) a Successor, provided that prior to or simultaneously with any such Transfer, such Affiliated Entity or Successor, as the case may be, and Tenant execute and deliver to Landlord an assignment and assumption agreement in form and substance reasonably acceptable to Landlord whereby such Affiliated Entity or Successor, as the case may be, shall agree to be independently bound by and upon all the covenants, agreements, terms, provisions and conditions set forth in the Lease on the part of Tenant to be performed, and whereby such Affiliated Entity or Successor, as the case may be, shall expressly agree that the provisions of this Section 13 shall, notwithstanding such Transfer, continue to be binding upon it with respect to all future Transfers. For the purposes hereof, an "**Affiliated Entity**" shall be defined as any entity (a) that, in the case of an assignment of this Lease, has a net worth and other financial indicators demonstrating such entity's ability to perform all of Tenant's obligations hereunder, as evidenced by audited financial statements, or, in the case of a sublease, has the financial capability to perform the obligations assumed under the sublease; and (b) which is controlled by, is under common control with, or which controls Tenant. For the purposes hereof, a "**Successor**" shall be defined as any entity into or with which Tenant is merged or with which Tenant is consolidated or which acquires all or substantially all of Tenant's stock or assets, provided that the surviving entity shall have a net worth and other financial indicators sufficient to meet Tenant's obligations hereunder.

14. INSURANCE; INDEMNIFICATION; EXCULPATION

14.1 Tenant's Insurance.

(a) Tenant shall procure, pay for and keep in force throughout the Term (and for so long thereafter as Tenant remains in occupancy of the Premises) commercial general liability insurance insuring Tenant on an occurrence basis against all claims and demands for personal injury liability (including, without limitation, bodily injury, sickness, disease, and death) or damage to property which may be claimed to have occurred from and after the time any of the Tenant Parties shall first enter the Premises, of not less than One Million Dollars ($1,000,000) per occurrence and Two Million Dollars ($2,000,000) in the aggregate annually, and from time to time thereafter shall be not less than such higher amounts, if procurable, as may be reasonably required by Landlord. Tenant shall also carry umbrella liability coverage in an amount of no less than Ten Million Dollars ($10,000,000). Such policy shall also include contractual liability coverage covering Tenant's liability assumed under this Lease, including without limitation Tenant's indemnification obligations. Such insurance policy(ies) shall name Landlord, Landlord's managing agent and persons claiming by, through or under them, if any, as additional insureds.

(b) Tenant shall take out and maintain throughout the Term a policy of fire, vandalism, malicious mischief, extended coverage and so-called "all risk" coverage insurance in an amount equal to one hundred percent (100%) of the replacement cost insuring (i) all items or components of Alterations (collectively, the "**Tenant-Insured Improvements**"), and (ii) all of Tenant's furniture, equipment, fixtures and property of every kind, nature and description related or arising out of Tenant's leasehold estate hereunder, which may be in or upon the Premises or the Building, including without limitation Tenant's Penthouse Equipment and all of Tenant's animals

(collectively, "**Tenant's Property**"). Such insurance required to be maintained by Tenant pursuant to this Section 14.1(b) (referred to herein as "**Tenant Property Insurance**") shall insure the interests of both Landlord and Tenant as their respective interests may appear from time to time.

(c) Tenant shall take out and maintain a policy of business interruption insurance throughout the Term sufficient to cover at least twelve (12) months of Rent due hereunder and Tenant's business losses during such 12-month period.

(d) During periods when Tenant's Work and/or any Alterations are being performed, Tenant shall maintain, or cause to be maintained, so-called all risk or special cause of loss property insurance or its equivalent and/or builders risk insurance on 100% replacement cost coverage basis, including hard and soft costs coverages. Such insurance shall protect and insure Landlord, Landlord's agents, Tenant and Tenant's contractors, as their interests may appear, against loss or damage by fire, water damage, vandalism and malicious mischief, and such other risks as are customarily covered by so-called all risk or special cause of loss property / builders risk coverage or its equivalent.

(e) Tenant shall procure and maintain at its sole expense such additional insurance as may be necessary to comply with any Legal Requirements.

(f) Tenant shall cause all contractors and subcontractors to maintain during the performance of any Alterations the insurance described in Exhibit 10 attached hereto.

(g) The insurance required pursuant to Sections 14.1(a), (b), (c), (d) and (e) (collectively, "**Tenant's Insurance Policies**") shall be effected with insurers approved by Landlord, with a rating of not less than "A-XI" in the current *Best's Insurance Reports*, and authorized to do business in the Commonwealth of Massachusetts under valid and enforceable policies. Tenant's Insurance Policies shall each provide that it shall not be canceled without at least thirty (30) days' prior written notice to each insured named therein. Tenant's Insurance Policies may include deductibles in an amount no greater than the greater of $25,000 or commercially reasonable amounts. On or before the date on which any of the Tenant Parties shall first enter the Premises and thereafter not less than fifteen (15) days prior to the expiration date of each expiring policy, Tenant shall deliver to Landlord binders of Tenant's Insurance Policies issued by the respective insurers setting forth in full the provisions thereof together with evidence satisfactory to Landlord of the payment of all premiums for such policies. In the event of any claim, and upon Landlord's request, Tenant shall deliver to Landlord complete copies of Tenant's Insurance Policies. Upon request of Landlord, Tenant shall deliver to any Mortgagee copies of the foregoing documents.

14.2 Indemnification.

(a) Except to the extent caused by the gross negligence, willful misconduct or breach of this Lease of and by any of the Landlord Parties, Tenant shall defend, indemnify and save the Landlord Parties harmless from and against any and all Claims asserted by or on behalf of any person, firm, corporation or public authority arising from:

(i) Tenant's breach of any covenant or obligation under this Lease;

(ii) Any injury to or death of any person, or loss of or damage to property, sustained or occurring in, upon, at or about the Premises;

(iii) Any injury to or death of any person, or loss of or damage to property arising out of the use or occupancy of the Premises by or the negligence or willful misconduct of any of the Tenant Parties; and

(iv) On account of or based upon any work or thing whatsoever done (other than by Landlord or any of the Landlord Parties) at the Premises during the Term and during the period of time, if any, prior to the Term Commencement Date that any of the Tenant Parties may have been given access to the Premises.

(b) Landlord shall defend, indemnify and save the Tenant harmless from and against any and all Claims asserted by or on behalf of any person, firm, corporation or public authority to the extent arising from Landlord's gross negligence, willful misconduct or breach of this Lease Agreement.

14.3 Property of Tenant. Tenant covenants and agrees that, except to the extent caused by the gross negligence, willful misconduct or breach of this Lease of and by any of the Landlord Parties to the maximum extent permitted by Legal Requirements, all of Tenant's Property at the Premises shall be at the sole risk and hazard of Tenant, and that if the whole or any part thereof shall be damaged, destroyed, stolen or removed from any cause or reason whatsoever, no part of said damage or loss shall be charged to, or borne by, Landlord, except, subject to Section 14.5 hereof, to the extent such damage or loss is due to the gross negligence, willful misconduct or breach of this Lease Agreement of or by any of the Landlord Parties.

14.4 Limitation of Landlord's Liability for Damage or Injury. Landlord shall not be liable for any injury or damage to persons, animals or property resulting from fire, explosion, falling plaster, steam, gas, air contaminants or emissions, electricity, electrical or electronic emanations or disturbance, water, rain or snow or leaks from any part of the Building or from the pipes, appliances, equipment or plumbing works or from the roof, street or sub-surface or from any other place or caused by dampness, vandalism, malicious mischief or by any other cause of whatever nature, except to the extent caused by or due to the gross negligence, willful misconduct or breach of this Lease Agreement of and by any of the Landlord Parties, and then, where notice and an opportunity to cure are appropriate (i.e., where Tenant has an opportunity to know or should have known of such condition sufficiently in advance of the occurrence of any such injury or damage resulting therefrom as would have enabled Landlord to prevent such damage or loss had Tenant notified Landlord of such condition) only after (i) notice to Landlord of the condition claimed to constitute gross negligence, willful misconduct or a breach of this Lease Agreement, and (ii) the expiration of a reasonable time after such notice has been received by Landlord without Landlord having commenced to take all reasonable and practicable means to cure or correct such condition; and pending such cure or correction by Landlord, Tenant shall take all reasonably prudent temporary measures and safeguards to prevent any injury, loss or damage to persons or property. Notwithstanding the foregoing, in no event shall any of the Landlord Parties be liable for any loss which is covered by insurance policies actually carried or required to be so carried by this Lease; nor shall any of the Landlord Parties be liable for any such damage caused by other tenants or persons in the Building or caused by operations in construction of any private, public,

or quasi-public work; nor shall any of the Landlord Parties be liable for any damage or injury in connection with any latent defect in the Premises or in the Building.

14.5 Waiver of Subrogation; Mutual Release. Landlord and Tenant each hereby waives on behalf of itself and its property (i.e., as opposed to liability) insurers (none of which shall ever be assigned any such claim or be entitled thereto due to subrogation or otherwise) any and all rights of recovery, claim, action, or cause of action against the other and its agents, officers, servants, partners, shareholders, or employees (collectively, the "**Related Parties**") for any loss or damage that may occur to or within the Premises or the Building or any improvements thereto, or any personal property of such party therein which is insured against under any property insurance policy actually being maintained by the waiving party from time to time, even if not required hereunder, or which would be insured against under the terms of any insurance policy required to be carried or maintained by the waiving party hereunder, whether or not such insurance coverage is actually being maintained, including, in every instance, such loss or damage that may be caused by the negligence of the other party hereto and/or its Related Parties. Landlord and Tenant each agrees to cause appropriate clauses to be included in its property insurance policies necessary to implement the foregoing provisions.

14.6 Tenant's Acts--Effect on Insurance. Tenant shall not do or permit any Tenant Party to do any act or thing upon the Premises or elsewhere in the Building which will invalidate or be in conflict with any insurance policies covering the Building and the fixtures and property therein; and shall not do, or permit to be done, any act or thing upon the Premises which shall subject Landlord to any liability or responsibility for injury to any person or persons or to property by reason of any business or operation being carried on upon said Premises or for any other reason. If by reason of the failure of Tenant to comply with the provisions hereof the insurance rate applicable to any policy of insurance shall at any time thereafter be higher than it otherwise would be, Tenant shall reimburse Landlord upon demand for that part of any insurance premiums which shall have been charged because of such failure by Tenant, together with interest at the Default Rate until paid in full, within ten (10) days after receipt of an invoice therefor. In addition, Tenant shall reimburse Landlord for any increase in insurance premium arising as a result of Tenant's use and/or storage of any Hazardous Materials in the Premises.

14.7 Landlord's Insurance. Landlord shall carry at all times during the Term of this Lease: (i) commercial general liability insurance with respect to the Building, the Land and the Common Areas thereof in an amount not less than Five Million Dollars ($5,000,000) combined single limit per occurrence, (ii) with respect to the Building, excluding Tenant-Insured Improvements and improvements made by other tenants or occupants, insurance against loss or damage caused by any peril covered under fire, extended coverage and all risk insurance with coverage against vandalism, malicious mischief and such other insurable hazards and contingencies as are from time to time normally insured against by owners of similar first class offices/research/laboratory buildings/campuses in the Market Area or which are required by Landlord's mortgagee, in an amount equal to one hundred percent (100%) of the full replacement cost thereof above foundation walls ("**Landlord Property Insurance**"), and (iii) rent interruption insurance covering at least eighteen (18) months. Any and all such insurance: (x) may be maintained under a blanket policy affecting other properties of Landlord and/or its affiliated business organizations, and (y) may be written with commercially reasonable deductibles as determined by Landlord. The costs incurred by Landlord related to such insurance shall be

included in Operating Costs. Tenant Property Insurance and Landlord Property Insurance are referred to collectively herein as "**Property Insurance**".

15. CASUALTY; TAKING

15.1 Damage. If the Premises are damaged in whole or part because of fire or other insured casualty ("**Casualty**"), or if the Premises are subject to a taking in connection with the exercise of any power of eminent domain, condemnation, or purchase under threat or in lieu thereof (any of the foregoing, a "**Taking**"), then unless this Lease is terminated in accordance with Section **15.2** below, Landlord shall restore the Building and/or the Premises to substantially the same condition as existed immediately following completion of Landlord's Work, or in the event of a partial Taking which affects the Building and the Premises, restore the remainder of the Building and the Premises not so Taken to substantially the same condition as is reasonably feasible. If, in Landlord's reasonable judgment, any element of the Tenant-Insured Improvements can more effectively be restored as an integral part of Landlord's restoration of the Building or the Premises, such restoration shall also be made by Landlord, but at Tenant's sole cost and expense. Subject to rights of Mortgagees, Tenant Delays, Legal Requirements then in existence and to delays for adjustment of insurance proceeds or Taking awards, as the case may be, and instances of Landlord's Force Majeure, Landlord shall substantially complete such restoration within one (1) year after Landlord's receipt of all required permits therefor with respect to substantial reconstruction of at least 50% of the Building, or, within one hundred eighty (180) days after Landlord's receipt of all required permits therefor in the case of restoration of less than 50% of the Building. Upon substantial completion of such restoration by Landlord, Tenant shall use diligent efforts to complete restoration of the Premises to substantially the same condition as existed immediately prior to such Casualty or Taking, as the case may be, as soon as reasonably possible. Tenant agrees to cooperate with Landlord in such manner as Landlord may reasonably request to assist Landlord in collecting insurance proceeds due in connection with any Casualty which affects the Premises or the Building. In no event shall Landlord be required to expend more than the Net (hereinafter defined) insurance proceeds Landlord receives for damage to the Premises and/or the Building or the Net Taking award attributable to the Premises and/or the Building. "**Net**" means the insurance proceeds or Taking award actually paid to Landlord (and not paid over to a Mortgagee) less all costs and expenses, including adjusters and attorney's fees, of obtaining the same. In the Operating Year in which a Casualty occurs, there shall be included in Operating Costs Landlord's deductible under its property insurance policy. Except as Landlord may elect pursuant to this Section 15.1, under no circumstances shall Landlord be required to repair any damage to, or make any repairs to or replacements of, any Tenant-Insured Improvements.

15.2 Termination Rights.

(a) Landlord's Termination Rights. Landlord may terminate this Lease upon thirty (30) days' prior written notice to Tenant if:

(i) any material portion of the Building or any material means of access

thereto is taken;

Casualty; or

(ii) more than thirty-five percent (35%) of the Building is damaged by

(iii) if the estimated time to complete restoration exceeds one (1) year from the date on which Landlord receives all required permits for such restoration.

(b) Tenant's Termination Right. If Landlord is so required but fails to complete restoration of the Premises within the time frames and subject to the conditions set forth in Section 15.1 above, then Tenant may terminate this Lease upon thirty (30) days' written notice to Landlord; provided, however, that if Landlord completes such restoration within thirty (30) days after receipt of any such termination notice, such termination notice shall be null and void and this Lease shall continue in full force and effect. The remedies set forth in this Section 15.2(b) and in Section 15.2(c) below are Tenant's sole and exclusive rights and remedies based upon Landlord's failure to complete the restoration of the Premises as set forth herein. Notwithstanding anything to the contrary contained herein, Tenant shall not have the right to terminate this Lease pursuant to this Section 15 if the Casualty was caused by the negligence or intentional misconduct of any Tenant Party.

(c) Further Termination Rights. In the case of any Casualty or Taking affecting the Premises and occurring during the last twelve (12) months of the Term, then (i) if such Casualty or Taking results in more than twenty-five percent (25%) of the floor area of the Premises being unsuitable for the Permitted Uses, or (ii) the damage to the Premises costs more than $250,000 to restore, then either Landlord or Tenant shall have the option to terminate this Lease upon thirty (30) days' written notice to the other. In addition, if Landlord's Mortgagee does not release sufficient insurance proceeds to cover the cost of Landlord's restoration obligations, then Landlord shall (i) notify Tenant thereof, and (ii) have the right to terminate this Lease. If Landlord does not terminate this Lease pursuant to the previous sentence and such notice by Landlord does not include an agreement by Landlord to pay for the difference between the cost of such restoration and such released insurance proceeds, then Tenant may terminate this Lease by written notice to Landlord on or before the date that is thirty (30) days after such notice. Notwithstanding anything to the contrary contained in this Section 15, in no event may Tenant elect to terminate this Lease hereunder if the Casualty that would otherwise give rise to such right results from the gross negligence or willful misconduct of Tenant, its agents, contractors, or employees.

(d) Automatic Termination. In the case of a Taking of the entire Premises, then this Lease shall automatically terminate as of the date of possession by the Taking authority.

15.3 Rent Abatement. In the event of a Casualty affecting the Premises, there shall be an equitable adjustment of Base Rent, Operating Costs and Taxes based upon the degree to which Tenant's ability to conduct its business in the Premises is impaired by reason of such Casualty from and after the date of a Casualty, and continuing until the following portions of the repair and restoration work to be performed by Landlord, as set forth above, are substantially completed: (i) any repair and restoration work to be performed by Landlord within the Premises, and (ii) repair and restoration work with respect to the Common Areas to the extent that damage to the Common Areas caused by such Casualty materially adversely affects Tenant's use of, or access to, the Premises.

15.4 Taking for Temporary Use. If the Premises are Taken for temporary use, this Lease and Tenant's obligations, including without limitation the payment of Rent, shall continue.

For purposes hereof, a "**Taking for temporary use**" shall mean a Taking of ninety (90) days or less.

15.5 Disposition of Awards. Except for any separate award for Tenant's movable trade fixtures, relocation expenses, and unamortized leasehold improvements paid for by Tenant (provided that the same may not reduce Landlord's award), all Taking awards to Landlord or Tenant shall be Landlord's property without Tenant's participation, and Tenant hereby assigns to Landlord Tenant's interest, if any, in such award. Tenant may pursue its own claim against the Taking authority.

16. ESTOPPEL CERTIFICATE.

Tenant shall at any time and from time to time upon not less than ten (10) days' prior notice from Landlord, execute, acknowledge and deliver to Landlord a statement in writing certifying that this Lease is unmodified and in full force and effect (or if there have been modifications, that the same is in full force and effect as modified and stating the modifications), and the dates to which Rent has been paid in advance, if any, stating whether or not Landlord is in default in performance of any covenant, agreement, term, provision or condition contained in this Lease and, if so, specifying each such default, and such other facts as Landlord may reasonably request, it being intended that any such statement delivered pursuant hereto may be relied upon by any prospective purchaser of the Building or of any interest of Landlord therein, any Mortgagee or prospective Mortgagee thereof, any lessor or prospective lessor thereof, any lessee or prospective lessee thereof, or any prospective assignee of any mortgage thereof. *Time is of the essence with respect to any such requested certificate*, Tenant hereby acknowledging the importance of such certificates in mortgage financing arrangements, prospective sales and the like. If Tenant shall fail to execute and deliver to Landlord any such statement within such ten-day period, Tenant hereby appoints Landlord as Tenant's attorney-in-fact in its name and behalf to execute such statement, such appointment being coupled with an interest.

17. HAZARDOUS MATERIALS

17.1 Prohibition.

(a) Tenant shall not, without the prior written consent of Landlord, bring or permit to be brought or kept in or on the Premises or elsewhere in the Building or the Property (i) any inflammable, combustible or explosive fluid, material, chemical or substance (except for standard office supplies stored in proper containers); and (ii) any Hazardous Material (hereinafter defined), other than, if Tenant's use of the Premises includes research, development, warehouse, laboratory use, or other ancillary uses related to the foregoing, the types and quantities of Hazardous Materials which are approved by Landlord in advance, which approval shall not be unreasonably withheld, conditioned or delayed ("**Tenant's Hazardous Materials**"), provided that the same shall at all times be:

(i) brought upon, kept or used in Tenant's Control Areas (as hereinafter

defined);

defined;

(ii) in compliance with the Control Area Limitations, as hereinafter

(iii) in accordance with all applicable Legal Requirements, including, without limitation, all applicable Environmental Laws (hereinafter defined); and

(iv) in accordance with prudent environmental practice and (with respect to medical waste and so-called "biohazard" materials) good scientific and medical practice.

(b) "**Tenant's Control Areas**" consist of the entirety of the Prime Premises and the Storage Area. The "**Control Areas Limitations**" are determined in accordance with the International Building Code (2018) ("**IBC**"), and are as follows:

(i) Prime Premises. The parties acknowledge that the Prime Premises on the fourth floor shall be deemed to consist of two (2) Control Areas, as defined by the IBC, and Tenant shall not, in the Prime Premises, exceed the limitations which are imposed by the IBC on use and storage of Hazardous Materials for premises consisting of two Control Areas, and

(ii) Storage Area. Tenant shall not, at any time, exceed in the Storage Area, the solvent storage capacity permitted for one Control Area under the IBC.

(c) Tenant shall be responsible for assuring that all laboratory uses are adequately and properly vented. On or before each anniversary of the Term Commencement Date, and on any earlier date during the 12-month period on which Tenant intends to add a new Hazardous Material or materially increase the quantity of any Hazardous Material to the list of Tenant's Hazardous Materials, Tenant shall submit to Landlord an updated list of Tenant's Hazardous Materials for Landlord's review and approval, which approval shall not be unreasonably withheld, conditioned or delayed. Landlord shall have the right, from time to time, to inspect the Premises for compliance with the terms of this Section 17.1. Notwithstanding the foregoing, with respect to any of Tenant's Hazardous Materials which Tenant does not properly handle, store or dispose of in compliance with all applicable Environmental Laws (hereinafter defined), prudent environmental practice and (with respect to medical waste and so-called "biohazard materials") good scientific and medical practice, Tenant shall, upon written notice from Landlord, no longer have the right to bring such material into the Building or the Property until Tenant has demonstrated, to Landlord's reasonable satisfaction, that Tenant has implemented programs to thereafter properly handle, store or dispose of such material. In order to induce Landlord to waive its otherwise applicable requirement that Tenant maintain insurance in favor of Landlord against liability arising from the presence of radioactive materials in the Premises, and without limiting the foregoing, Tenant hereby represents and warrants to Landlord that at no time during the Term will Tenant bring upon, or permit to be brought upon, the Premises any radioactive materials whatsoever.

17.2 Environmental Laws. For purposes hereof, "**Environmental Laws**" shall mean all laws, statutes, ordinances, rules and regulations of any local, state or federal governmental authority having jurisdiction concerning environmental, health and safety matters, including but not limited to any discharge by any of the Tenant Parties into the air, surface water, sewers, soil or groundwater of any Hazardous Material (hereinafter defined) whether within or outside the Premises, including, without limitation (a) the Federal Water Pollution Control Act, 33 U.S.C. Section 1251 et seq., (b) the Federal Resource Conservation and Recovery Act, 42 U.S.C. Section 6901 et seq., (c) the Comprehensive Environmental Response, Compensation and Liability Act,

42 U.S.C. Section 9601 et seq., (d) the Toxic Substances Control Act of 1976, 15 U.S.C. Section 2601 et seq., and (e) Chapter 21E of the General Laws of Massachusetts. Tenant, at its sole cost and expense, shall comply with (i) Environmental Laws, and (ii) any rules, requirements and safety procedures of the Massachusetts Department of Environmental Protection, the Town of Lexington and any insurer of the Building or the Premises with respect to Tenant's use, storage and disposal of any Hazardous Materials.

17.3 Hazardous Material Defined. As used herein, the term "**Hazardous Material**" means asbestos, oil or any hazardous, radioactive or toxic substance, material or waste or petroleum derivative which is or becomes regulated by any Environmental Law, including without limitation live organisms, viruses and fungi, medical waste and any so-called "biohazard" materials. The term "**Hazardous Material**" includes, without limitation, oil and/or any material or substance which is (i) designated as a "hazardous substance," "hazardous material," "oil," "hazardous waste" or toxic substance under any Environmental Law.

17.4 Chemical Safety Program. If at any time during the Term, Tenant's use of the Premises includes research, development, warehouse, laboratory use, or other ancillary uses related to the foregoing, Tenant shall establish and maintain a chemical safety program administered by a licensed, qualified individual in accordance with the requirements of any applicable governmental authority. Tenant shall be solely responsible for all costs incurred in connection with such chemical safety program, and Tenant shall provide Landlord with such documentation as Landlord may reasonably require evidencing Tenant's compliance with the requirements of (a) any applicable governmental authority with respect to such chemical safety program and (b) this Section. Tenant shall obtain and maintain during the Term any permit required by any such applicable governmental authority.

17.5 Testing. If any Mortgagee or governmental authority requires testing to determine whether there has been any release of Hazardous Materials and such testing is required as a result of the acts or omissions of any of the Tenant Parties, then Tenant shall reimburse Landlord upon demand, as additional rent, for the reasonable costs thereof, together with interest at the Default Rate until paid in full. Tenant shall execute affidavits, certifications and the like, as may be reasonably requested by Landlord from time to time concerning Tenant's best knowledge and belief concerning the presence of Hazardous Materials in or on the Premises, the Building or the Property. In addition to the foregoing, if Landlord reasonably believes that any Hazardous Materials have been released on the Premises in violation of this Lease or any Legal Requirement, Landlord shall have the right to conduct appropriate tests of the Premises or any portion thereof to demonstrate that Hazardous Materials are present or that contamination has occurred due to the acts or omissions of any of the Tenant Parties. Tenant shall pay all reasonable costs of such tests if such tests reveal that Hazardous Materials exist at the Premises in material violation of this Lease or any Legal Requirement. Further, Landlord shall have the right to cause a third party consultant retained by Landlord, at Landlord's expense (provided, however, that such costs shall be included in Operating Costs), to review, but not more than once in any calendar year, Tenant's lab operations, procedures and permits to ascertain whether or not Tenant is complying with law and adhering to best industry practices. Tenant agrees to cooperate in good faith with any such review and to provide to such consultant any information requested by such consultant and reasonably required in order for such consultant to perform such review, but nothing contained herein shall require Tenant to provide proprietary or confidential information to such consultant.

17.6 Indemnity; Remediation.

(a) Tenant hereby covenants and agrees to indemnify, defend and hold the Landlord Parties harmless from and against any and all Claims against any of the Landlord Parties arising out of contamination of any part of the Property or other adjacent property, which contamination arises as a result of: (i) the presence of Hazardous Material in the Premises, the presence of which is caused by any act or omission of any of the Tenant Parties, or (ii) from a breach by Tenant of its obligations under this Section 17. This indemnification of the Landlord Parties by Tenant includes, without limitation, reasonable costs incurred in connection with any investigation of site conditions or any cleanup, remedial, removal or restoration work or any other response actions required by any federal, state or local governmental agency or political subdivision because of Hazardous Material present in the soil, soil vapor or ground water on or under or any indoor air in the Building based upon the circumstances identified in the first sentence of this Section 17.6. The indemnification and hold harmless obligations of Tenant under this Section 17.6 shall survive the expiration or any earlier termination of this Lease. Without limiting the foregoing, if the presence of any Hazardous Material in the Building or otherwise in the Property is caused or permitted by any of the Tenant Parties and results in any contamination of any part of the Property or any adjacent property, Tenant shall promptly take all actions at Tenant's sole cost and expense as are necessary to return the Property and/or the Building or any adjacent property to their condition as of the date of this Lease, provided that Tenant shall first obtain Landlord's written approval of such actions, which approval shall not be unreasonably withheld, conditioned or delayed so long as such actions, in Landlord's reasonable discretion, would not potentially have any adverse effect on the Property, and, in any event, Landlord shall not withhold its approval of any proposed actions which are required by applicable Environmental Laws. The provisions of this Section 17.6 shall survive the expiration or earlier termination of the Lease.

(b) Without limiting the obligations set forth in Section 17.6(a) above, if any Hazardous Material is in, on, under, at or about the Building or the Property as a result of the acts or omissions of any of the Tenant Parties and results in any contamination of any part of the Property or any adjacent property that is in violation of any applicable Environmental Law or that requires the performance of any response action pursuant to any Environmental Law, Tenant shall promptly take all actions at Tenant's sole cost and expense as are necessary to reduce such Hazardous Material to amounts below any applicable Reportable Quantity, any applicable Reportable Concentration and any other applicable standard set forth in any Environmental Law such that no further response actions are required; provided that Tenant shall first obtain Landlord's written approval of such actions, which approval shall not be unreasonably withheld, conditioned or delayed so long as such actions would not be reasonably expected to have an adverse effect on the market value or utility of the Property for the Permitted Uses, and in any event, Landlord shall not withhold its approval of any proposed actions which are required by applicable Environmental Laws (such approved actions, "**Tenant's Remediation**").

(c) In the event that Tenant fails to complete Tenant's Remediation prior to the end of the Term, then:

(i) until the completion of Tenant's Remediation (as evidenced by the certification of Tenant's Licensed Site Professional (as such term is defined by applicable Environmental Laws), who shall be reasonably acceptable to Landlord) (the "**Remediation**

Completion Date"), Tenant shall pay to Landlord, with respect to the portion of the Premises which reasonably cannot be occupied by a new tenant until completion of Tenant's Remediation,
(A) additional rent on account of Operating Costs and Taxes and (B) Base Rent in an amount equal to the greater of (1) the fair market rental value of such portion of the Premises (determined in substantial accordance with the process described in Section 1.2 above), and (2) Base Rent attributable to such portion of the Premises in effect immediately prior to the end of the Term; and

(ii) Tenant shall maintain responsibility for Tenant's Remediation and Tenant shall complete Tenant's Remediation as soon as reasonably practicable in accordance with Environmental Laws. If Tenant does not diligently pursue completion of Tenant's Remediation, Landlord shall have the right to either (A) assume control for overseeing Tenant's Remediation, in which event Tenant shall pay all reasonable costs and expenses of Tenant's Remediation (it being understood and agreed that all costs and expenses of Tenant's Remediation incurred pursuant to contracts entered into by Tenant shall be deemed reasonable) within thirty (30) days of demand therefor (which demand shall be made no more often than monthly), and Landlord shall be substituted as the party identified on any governmental filings as the party responsible for the performance of such Tenant's Remediation or (B) require Tenant to maintain responsibility for Tenant's Remediation, in which event Tenant shall complete Tenant's Remediation as soon as reasonably practicable in accordance with Environmental Laws, it being understood that Tenant's Remediation shall not contain any requirement that Tenant remediate any contamination to levels or standards more stringent than those associated with the Property's current office, research and development, laboratory, and vivarium uses.

(d) The provisions of this Section 17.6 shall survive the expiration or earlier termination of this Lease.

17.7 Disclosures. Prior to bringing any Hazardous Material into any part of the Property, Tenant shall deliver to Landlord the following information with respect thereto: (a) a description of handling, storage, use and disposal procedures; (b) all plans or disclosures and/or emergency response plans which Tenant has prepared, including without limitation Tenant's Spill Response Plan, and all plans which Tenant is required to supply to any governmental agency or authority pursuant to any Environmental Laws; (c) copies of all Required Permits relating thereto; and (d) other information reasonably requested by Landlord.

17.8 Removal. Tenant shall be responsible, at its sole cost and expense, for Hazardous Material and other biohazard disposal services for the Premises. Such services shall be performed by contractors reasonably acceptable to Landlord and on a sufficient basis to ensure that the Premises are at all times kept neat, clean and free of Hazardous Materials and biohazards except in appropriate, specially marked containers reasonably approved by Landlord.

18. RULES AND REGULATIONS.

18.1 Rules and Regulations. Tenant will faithfully observe and comply with the Rules and Regulations attached hereto as Exhibits 9-1 and 9-2 ("**Current Rules and Regulations**") and reasonable rules and regulations as may be promulgated, from time to time, with respect to the Building, the Property and construction within the Property (collectively, the "**Rules and Regulations**"). The Current Rules and Regulations consist of the Building Rules and Regulations

attached hereto as Exhibit 9-1 and the Construction Rules and Regulations attached hereto as Exhibit 9-2. In the case of any conflict between the provisions of this Lease and any future rules and regulations, the provisions of this Lease shall control. Nothing contained in this Lease shall be construed to impose upon Landlord any duty or obligation to enforce the Rules and Regulations or the terms, covenants or conditions in any other lease as against any other tenant and Landlord shall not be liable to Tenant for violation of the same by any other tenant, its servants, employees, agents, contractors, visitors, invitees or licensees.

18.2 Energy Conservation. Landlord may institute upon written notice to Tenant such policies, programs and measures as may be necessary, required, or expedient for the conservation and/or preservation of energy or energy services (collectively, the "**Conservation Program**"), provided however, that the Conservation Program does not, by reason of such policies, programs and measures, reduce the level of energy or energy services being provided to the Premises below the level of energy or energy services then being provided in comparable combination laboratory, research and development and office buildings in the vicinity of the Premises, or as may be necessary or required to comply with Legal Requirements or standards or the other provisions of this Lease. Upon receipt of such notice, Tenant shall comply with the Conservation Program unless Tenant demonstrates that such compliance places an unreasonable financial or operational burden on Tenant.

18.3 Recycling. Upon written notice, Landlord may establish commercially reasonable policies, programs and measures for the recycling of paper, products, plastic, tin and other materials (a "**Recycling Program**"). Upon receipt of such notice, Tenant will comply with the Recycling Program at Tenant's sole cost and expense.

19. LAWS AND PERMITS.

19.1 Legal Requirements. Tenant shall not cause or permit the Premises, or cause the Property or the Building to be used in any way that violates any Legal Requirement, order, permit, approval, variance, covenant or restrictions of record or any provisions of this Lease, interferes with the rights of tenants of the Building, or constitutes a nuisance or waste. Tenant shall obtain, maintain and pay for all permits and approvals needed for the operation of Tenant's business and/or Tenant's Penthouse Equipment, as soon as reasonably possible, and in any event shall not undertake any operations or use of Tenant's Penthouse Equipment unless all applicable permits and approvals are in place and shall, promptly take all actions necessary to comply with all Legal Requirements, including, without limitation, the Occupational Safety and Health Act, applicable to Tenant's use of the Premises, the Property or the Building. Tenant shall maintain in full force and effect all certifications or permissions required by any authority having jurisdiction to authorize, franchise or regulate Tenant's use of the Premises. Tenant shall be solely responsible for procuring and complying at all times with any and all necessary permits and approvals directly or indirectly relating or incident to: the conduct of its activities on the Premises; its scientific experimentation, transportation, storage, handling, use and disposal of any chemical or radioactive or bacteriological or pathological substances or organisms or other hazardous wastes or environmentally dangerous substances or materials or medical waste or animals or laboratory specimens. Within ten (10) days of a request by Landlord, which request shall be made not more than once during each period of twelve (12) consecutive months during the Term hereof, unless otherwise requested by any mortgagee of Landlord or unless Landlord reasonably suspects that

Tenant has violated the provisions of this Section 19.1, Tenant shall furnish Landlord with copies of all such permits and approvals that Tenant possesses or has obtained together with a certificate certifying that such permits are all of the permits that Tenant possesses or has obtained with respect to the Premises. Tenant shall promptly give written notice to Landlord of any warnings or violations relative to the above received from any federal, state or municipal agency or by any court of law and shall promptly cure the conditions causing any such violations. Tenant shall not be deemed to be in default of its obligations under the preceding sentence to promptly cure any condition causing any such violation in the event that, in lieu of such cure, Tenant shall contest the validity of such violation by appellate or other proceedings permitted under applicable law, provided that: (i) any such contest is made reasonably and in good faith, (ii) Tenant makes provisions, including, without limitation, posting bond(s) or giving other security, reasonably acceptable to Landlord to protect Landlord, the Building and the Property from any liability, costs, damages or expenses arising in connection with such alleged violation and failure to cure, (iii) Tenant shall agree to indemnify, defend (with counsel reasonably acceptable to Landlord) and hold Landlord harmless from and against any and all liability, costs, damages, or expenses arising in connection with such condition and/or violation, (iv) Tenant shall promptly cure any violation in the event that its appeal of such violation is overruled or rejected, and (v) Tenant's decision to delay such cure shall not, in Landlord's good faith determination, be likely to result in any actual or threatened bodily injury, property damage, or any civil or criminal liability to Landlord, any tenant or occupant of the Building or the Property, or any other person or entity. Nothing contained in this Section 19.1 shall be construed to expand the uses permitted hereunder beyond the Permitted Uses. Landlord shall comply with any Legal Requirements and with any direction of any public office or officer relating to the maintenance or operation of the structural elements of the Building and the Common Areas, and the costs so incurred by Landlord shall be included in Operating Costs in accordance with the provisions of Section 5.2.

20. DEFAULT

20.1 Events of Default. The occurrence of any one or more of the following events shall constitute an "**Event of Default**" hereunder by Tenant:

(a) If Tenant fails to make any payment of Rent or any other payment required hereunder, as and when due, and such failure shall continue for a period of five (5) business days after notice thereof to Tenant; provided, however, an Event of Default shall occur hereunder without any obligation of Landlord to give any notice if (i) Tenant fails to make any payment within five (5) business days after the due date therefor, and (ii) Landlord has given Tenant written notice under this Section 20.1(a) on more than one (1) occasion during the twelve (12) month interval preceding such failure by Tenant;

(b) If Tenant shall abandon the Premises (whether or not the keys shall have been surrendered or the Rent shall have been paid);

(c) If Tenant shall fail to execute and deliver to Landlord an estoppel certificate pursuant to Section 16 above or a subordination and attornment agreement pursuant to Section 22 below, within the timeframes set forth therein, which failure continues for ten (10) days after notice to Tenant thereof;

(d) If Tenant shall fail to maintain any insurance required hereunder and Tenant fails to cure such default within three (3) business days of receiving notice of such default;

(e) If Tenant shall fail to restore the Security Deposit to its original amount or deliver a replacement Letter of Credit as required under Section 7 above and Tenant fails to cure such default within five (5) business days of receiving notice of such default;

(f) If Tenant causes or suffers any release of Hazardous Materials in or near the Property and Tenant fails to cure the same within thirty (30) days of receiving notice of such default;

(g) If Tenant shall make a Transfer in violation of the provisions of Section 13 above, or if any event shall occur or any contingency shall arise whereby this Lease, or the term and estate thereby created, would (by operation of law or otherwise) devolve upon or pass to any person, firm or corporation other than Tenant, except as expressly permitted under Section 13 hereof;

(h) If Tenant shall fail to perform its obligations under Section 3 hereof and such failure continues for more than thirty (30) days after notice thereof from Landlord;

(i) The failure by Tenant to observe or perform any of the covenants or provisions of this Lease to be observed or performed by Tenant, other than as specified above, and such failure continues for more than thirty (30) days after notice thereof from Landlord; provided, further, that if the nature of Tenant's default is such that more than thirty (30) days are reasonably required for its cure, then Tenant shall not be deemed to be in default if Tenant shall commence such cure within said thirty (30) day period and thereafter diligently prosecute such cure to completion, which completion shall occur not later than ninety (90) days from the date of such notice from Landlord;

(j) Tenant shall be involved in financial difficulties as evidenced by an admission in writing by Tenant of Tenant’s inability to pay its debts generally as they become due, or by the making or offering to make a composition of its debts with its creditors;

(k) Tenant shall make an assignment or trust mortgage, or other conveyance or transfer of like nature, of all or a substantial part of its property for the benefit of its creditors,

(l) an attachment on mesne process, on execution or otherwise, or other legal process shall issue against Tenant or its property and a sale of any of its assets shall be held thereunder;

(m) any judgment, attachment or the like in excess of $1,000,000 shall be entered, recorded or filed against Tenant in any court, registry, etc. and Tenant shall fail to pay such judgment within thirty (30) days after the judgment shall have become final beyond appeal or to discharge or secure by surety bond such lien, attachment, etc. within thirty (30) days of such entry, recording or filing, as the case may be;

(n) the leasehold hereby created shall be taken on execution or by other process of law and shall not be revested in Tenant within thirty (30) days thereafter;

(o) a receiver, sequesterer, trustee or similar officer shall be appointed by a court of competent jurisdiction to take charge of all or any part of Tenant's Property and such appointment shall not be vacated within thirty (30) days; and

(p) any proceeding shall be instituted by or against Tenant pursuant to any of the provisions of any Act of Congress or State law relating to bankruptcy, reorganizations, arrangements, compositions or other relief from creditors, and, in the case of any proceeding instituted against it, if Tenant shall fail to have such proceedings dismissed within thirty (30) days or if Tenant is adjudged bankrupt or insolvent as a result of any such proceeding.

Wherever "Tenant " is used in subsections (i), (j), (k), (l), (n) or (o) of this Section 20.1, it shall be deemed to include any parent entity of Tenant and any guarantor of any of Tenant's obligations under this Lease.

20.2 Remedies. Upon an Event of Default, Landlord may, by notice to Tenant, elect to terminate this Lease; and thereupon (and without prejudice to any remedies which might otherwise be available for arrears of Rent or preceding breach of covenant or agreement and without prejudice to Tenant's liability for damages as hereinafter stated), upon the giving of such notice, this Lease shall terminate as of the date specified therein as though that were the Expiration Date. Upon such termination, Landlord shall have the right to utilize the Security Deposit or draw down the entire Letter of Credit, as applicable, and apply the proceeds thereof to its damages hereunder. Without being taken or deemed to be guilty of any manner of trespass or conversion, and without being liable to indictment, prosecution or damages therefor, Landlord may, by lawful process, enter into and upon the Premises (or any part thereof in the name of the whole); repossess the same, as of its former estate; and expel Tenant and those claiming under Tenant. The words "re-entry" and "re-enter" as used in this Lease are not restricted to their technical legal meanings.

20.3 Damages - Termination.

(a) Upon the termination of this Lease under the provisions of this Section 20, Tenant shall pay to Landlord Rent up to the time of such termination, shall continue to be liable for any preceding breach of covenant, and in addition, shall pay to Landlord as damages, at the election of Landlord, either:

(i) the amount (discounted to present value at the rate of five percent (5%) per annum) by which, at the time of the termination of this Lease (or at any time thereafter if Landlord shall have initially elected damages under Section 20.3(a)(ii) below), (x) the aggregate of Rent projected over the period commencing with such termination and ending on the Expiration Date, exceeds (y) the aggregate projected rental value of the Premises for such period, taking into account a reasonable time period during which the Premises shall be unoccupied, plus all Reletting Costs (hereinafter defined); or

(ii) amounts equal to Rent which would have been payable by Tenant had this Lease not been so terminated, payable upon the due dates therefor specified herein following such termination and until the Expiration Date, *provided, however*, if Landlord shall re- let the Premises during such period, that Landlord shall credit Tenant with the net rents received by Landlord from such re-letting, such net rents to be determined by first deducting from the gross

rents as and when received by Landlord from such re-letting the expenses incurred or paid by Landlord in terminating this Lease, as well as the expenses of re-letting, including altering and preparing the Premises for new tenants, brokers' commissions, and all other similar and dissimilar expenses properly chargeable against the Premises and the rental therefrom (collectively, "**Releting Costs**"), it being understood that any such re-letting may be for a period equal to or shorter or longer than the remaining Term; and *provided, further*, that (x) in no event shall Tenant be entitled to receive any excess of such net rents over the sums payable by Tenant to Landlord hereunder and (y) in no event shall Tenant be entitled in any suit for the collection of damages pursuant to this Section 20.3(a)(ii) to a credit in respect of any net rents from a re-letting except to the extent that such net rents are actually received by Landlord prior to the commencement of such suit. If the Premises or any part thereof should be re-let in combination with other space, then proper apportionment on a square foot area basis shall be made of the rent received from such re- letting and of the expenses of re-letting.

(b) In calculating the amount due under Section 20.3(a)(i), above, there shall be included, in addition to the Base Rent, all other considerations agreed to be paid or performed by Tenant, including without limitation Tenant's Share of Operating Costs and Taxes, on the assumption that all such amounts and considerations would have increased at the rate of three percent (3%) per annum for the balance of the full term hereby granted.

(c) Suit or suits for the recovery of such damages, or any installments thereof, may be brought by Landlord from time to time at its election, and nothing contained herein shall be deemed to require Landlord to postpone suit until the date when the Term would have expired if it had not been terminated hereunder.

(d) Nothing herein contained shall be construed as limiting or precluding the recovery by Landlord against Tenant of any sums or damages to which, in addition to the damages particularly provided above, Landlord may lawfully be entitled by reason of any Event of Default hereunder.

(e) In lieu of any other damages or indemnity and in lieu of full recovery by Landlord of all sums payable under all the foregoing provisions of this Section 20.3, Landlord may, by written notice to Tenant, at any time after this Lease is terminated under any of the provisions herein contained or is otherwise terminated for breach of any obligation of Tenant and before such full recovery, elect to recover, and Tenant shall thereupon pay, as liquidated damages, an amount equal to the aggregate of (x) an amount equal to the lesser of (1) Rent accrued under this Lease in the twelve (12) months immediately prior to such termination, or (2) Rent payable during the remaining months of the Term if this Lease had not been terminated, plus (y) the amount of Rent accrued and unpaid at the time of termination, less (z) the amount of any recovery by Landlord under the foregoing provisions of this Section 20.3 up to the time of payment of such liquidated damages.

20.4 Landlord's Self-Help; Fees and Expenses. If Tenant shall default in the performance of any covenant on Tenant's part to be performed in this Lease contained, including without limitation the obligation to maintain the Premises in the required condition pursuant to Section 10.1 above, Landlord may, upon reasonable advance notice, except that no notice shall be required in an emergency, immediately, or at any time thereafter, perform the same for the account

of Tenant. Tenant shall pay to Landlord upon demand therefor any costs incurred by Landlord in connection therewith, together with interest at the Default Rate until paid in full. In addition, Tenant shall pay all of Landlord's costs and expenses, including without limitation reasonable attorneys' fees, incurred (i) in enforcing any obligation of Tenant under this Lease or (ii) as a result of Landlord or any of the Landlord Parties, without its fault, being made party to any litigation pending by or against any of the Tenant Parties.

20.5 Waiver of Redemption, Statutory Notice and Grace Periods. Tenant does hereby waive and surrender all rights and privileges which it might have under or by reason of any present or future Legal Requirements to redeem the Premises or to have a continuance of this Lease for the Term hereby demised after being dispossessed or ejected therefrom by process of law or under the terms of this Lease or after the termination of this Lease as herein provided. Except to the extent prohibited by Legal Requirements, any statutory notice and grace periods provided to Tenant by law are hereby expressly waived by Tenant.

20.6 Landlord's Remedies Not Exclusive. The specified remedies to which Landlord may resort hereunder are cumulative and are not intended to be exclusive of any remedies or means of redress to which Landlord may at any time be lawfully entitled, and Landlord may invoke any remedy (including the remedy of specific performance) allowed at law or in equity as if specific remedies were not herein provided for.

20.7 No Waiver. Landlord's failure to seek redress for violation, or to insist upon the strict performance, of any covenant or condition of this Lease, or any of the Rules and Regulations promulgated hereunder, shall not prevent a subsequent act, which would have originally constituted a violation, from having all the force and effect of an original violation. The receipt by Landlord of Rent with knowledge of the breach of any covenant of this Lease shall not be deemed a waiver of such breach. The failure of Landlord to enforce any of such Rules and Regulations against Tenant and/or any other tenant in the Building shall not be deemed a waiver of any such Rules and Regulations. No provisions of this Lease shall be deemed to have been waived by either party unless such waiver be in writing signed by such party. No payment by Tenant or receipt by Landlord of a lesser amount than the Rent herein stipulated shall be deemed to be other than on account of the stipulated Rent, nor shall any endorsement or statement on any check or any letter accompanying any check or payment as Rent be deemed an accord and satisfaction, and Landlord may accept such check or payment without prejudice to Landlord's right to recover the balance of such Rent or pursue any other remedy in this Lease provided.

20.8 Restrictions on Tenant's Rights. During the continuation of any Event of Default,

(a) Landlord shall not be obligated to provide Tenant with any notice pursuant to Sections 1.2 and 25.17 above; and (b) Tenant shall not have the right to make, nor to request Landlord's consent or approval with respect to, any Alterations or Transfers.

20.9 Landlord Default. Notwithstanding anything to the contrary contained in the Lease, Landlord shall in no event be in default in the performance of any of Landlord's obligations under this Lease unless Landlord shall have failed to perform such obligations within thirty (30) days (or such additional time as is reasonably required to correct any such default, provided Landlord commences cure within 30 days) after notice by Tenant to Landlord properly specifying wherein Landlord has failed to perform any such obligation. Except as expressly set forth in this

Lease, Tenant shall not have the right to terminate or cancel this Lease or to withhold rent or to set-off or deduct any claim or damages against rent as a result of any default by Landlord or breach by Landlord of its covenants or any warranties or promises hereunder, except in the case of a wrongful eviction of Tenant from the Premises (constructive or actual) by Landlord, unless the same continues after notice to Landlord thereof and an opportunity for Landlord to cure the same as set forth above. In addition, Tenant shall not assert any right to deduct the cost of repairs or any monetary claim against Landlord from rent thereafter due and payable under this Lease.

21. SURRENDER; ABANDONED PROPERTY; HOLD-OVER

21.1 Surrender

(a) Upon the expiration or earlier termination of the Term, Tenant shall (i) peaceably quit and surrender to Landlord the Premises (including without limitation all fixed lab benches, fume hoods, electric, plumbing, heating and sprinkling systems, fixtures and outlets, vaults, paneling, molding, shelving, radiator enclosures, cork, rubber, linoleum and composition floors, ventilating, silencing, air conditioning and cooling equipment therein, the Generator (if installed), and all other furniture, fixtures, and equipment that was either provided by Landlord or paid for in whole or in part by any allowance provided to Tenant by Landlord under this Lease) broom clean, in good order, repair and condition excepting only ordinary wear and tear and damage by fire or other insured Casualty; (ii) remove all of Tenant's Property, all autoclaves and cage washers and, to the extent specified by Landlord pursuant to Section 11.1(b), Alterations made by Tenant; (iii) remove the Landlord's Kitchen Work, including, without limitation, all fixtures and equipment, and restore the area in which the kitchen is located to shell condition; and (iv) repair any damages to the Premises or the Building caused by the installation or removal of Tenant's Property and/or such Alterations. Tenant's obligations under this Section 21.1(a) shall survive the expiration or earlier termination of this Lease.

(b) Prior to the expiration of this Lease (or within thirty (30) days after any earlier termination), Tenant shall clean and otherwise decommission all interior surfaces (including floors, walls, ceilings, and counters), piping, supply lines, waste lines, acid neutralization systems and plumbing in and/or exclusively serving the Premises, and all exhaust or other ductwork in and/or exclusively serving the Premises, in each case which has carried or released or been contacted by any Hazardous Materials or other chemical or biological materials used in the operation of the Premises, and shall otherwise clean the Premises so as to permit the Surrender Plan (defined below) to be issued. At least thirty (30) days prior to the expiration of the Term (or, if applicable, within five (5) business days after any earlier termination of this Lease), Tenant shall deliver to Landlord a reasonably detailed narrative description of the actions proposed (or required by any Legal Requirements) to be taken by Tenant in order to render the Premises (including any Alterations permitted or required by Landlord to remain therein) free of Hazardous Materials and otherwise released for unrestricted use and occupancy including without limitation (and to the extent applicable) causing the Premises to be decommissioned in accordance with the regulations of the U.S. Nuclear Regulatory Commission and/or the Massachusetts Department of Public health (the "**MDPH**") for the control of radiation, and cause the Premises to be released for unrestricted use by the Radiation Control Program of the MDPH (the "**Surrender Plan**"). The Surrender Plan
(i) shall be accompanied by a current list of (A) all Required Permits held by or on behalf of any Tenant Party with respect to Hazardous Materials in, on, under, at or about the Premises, and (B)

Tenant's Hazardous Materials, and (ii) shall be subject to the review and approval of Landlord's environmental consultant. In connection with review and approval of the Surrender Plan, upon request of Landlord, Tenant shall deliver to Landlord or its consultant such additional non- proprietary information concerning the use of and operations within the Premises as Landlord shall request. On or before the expiration of the Term (or within thirty (30) days after any earlier termination of this Lease, during which period Tenant's use and occupancy of the Premises shall be governed by Section 21.3 below), Tenant shall deliver to Landlord a certification from a third party certified industrial hygienist reasonably acceptable to Landlord certifying that the Premises do not contain any Hazardous Materials and evidence that the approved Surrender Plan shall have been satisfactorily completed by a contractor acceptable to Landlord, and Landlord shall have the right, subject to reimbursement at Tenant's expense as set forth below, to cause Landlord's environmental consultant to inspect the Premises and perform such additional procedures as may be deemed reasonably necessary to confirm that the Premises are, as of the expiration of the Term (or, if applicable, the date which is thirty (30) days after any earlier termination of this Lease), free of Hazardous Materials and otherwise available for unrestricted use and occupancy as aforesaid. Landlord shall have the unrestricted right to deliver the Surrender Plan and any report by Landlord's environmental consultant with respect to the surrender of the Premises to third parties. Such third parties and the Landlord Parties shall be entitled to rely on the Surrender Report. If Tenant shall fail to prepare or submit a Surrender Plan approved by Landlord, or if Tenant shall fail to complete the approved Surrender Plan, or if such Surrender Plan, whether or not approved by Landlord, shall fail to adequately address the use of Hazardous Materials by any of the Tenant Parties in, on, at, under or about the Premises, Landlord shall have the right to take any such actions as Landlord may deem reasonable or appropriate to assure that the Premises and the Property are surrendered in the condition required hereunder, the cost of which actions shall be reimbursed by Tenant as additional rent upon demand. Tenant's obligations under this Section 21.1(b) shall survive the expiration or earlier termination of the Term. Notwithstanding the foregoing, the provisions of this Section 21.1(b) shall not be applicable unless Tenant's use of the Premises includes laboratory use.

(c) No act or thing done by Landlord during the Term shall be deemed an acceptance of a surrender of the Premises, and no agreement to accept such surrender shall be valid, unless in writing signed by Landlord. Unless otherwise agreed by the parties in writing, no employee of Landlord or of Landlord's agents shall have any power to accept the keys of the Premises prior to the expiration or earlier termination of this Lease. The delivery of keys to any employee of Landlord or of Landlord's agents shall not operate as a termination of this Lease or a surrender of the Premises.

(d) Notwithstanding anything to the contrary contained herein, Tenant shall, at its sole cost and expense, remove from the Premises, prior to the end of the Term, any item installed by or for Tenant and which, pursuant to Legal Requirements, must be removed therefrom before the Premises may be used by a subsequent tenant.

21.2 Abandoned Property. After the expiration or earlier termination hereof, if Tenant fails to remove any property from the Building or the Premises which Tenant is obligated by the terms of this Lease to remove within ten (10) business days after written notice from Landlord, such property (the "**Abandoned Property**") shall be conclusively deemed to have been abandoned, and may either be retained by Landlord as its property or sold or otherwise disposed

of in such manner as Landlord may see fit. If any item of Abandoned Property shall be sold, Tenant hereby agrees that Landlord may receive and retain the proceeds of such sale and apply the same, at its option, to the expenses of the sale, the cost of moving and storage, any damages to which Landlord may be entitled under Section 20 hereof or pursuant to law, and to any arrears of Rent.

21.3 Holdover. If any of the Tenant Parties holds over (which term shall include, without limitation, the failure of Tenant or any Tenant Party to perform all of its obligations under Section 21.1 above) after the end of the Term, Tenant shall be deemed a tenant-at-sufferance subject to the provisions of this Lease; provided that whether or not Landlord has previously accepted payments of Rent from Tenant, (i) Tenant shall pay Base Rent at 150% of the highest rate of Base Rent payable during the Term, (ii) Tenant shall continue to pay to Landlord all additional rent, and (iii) Tenant shall be liable for all damages, including without limitation lost business and consequential damages, incurred by Landlord as a result of such holding over, Tenant hereby acknowledging that Landlord may need the Premises after the end of the Term for other tenants and that the damages which Landlord may suffer as the result of Tenant's holding over cannot be determined as of the Execution Date. Nothing contained herein shall grant Tenant the right to holdover after the expiration or earlier termination of the Term.

21.4 Warranties. Tenant hereby assigns to Landlord any warranties in effect on the last day of the Term with respect to any fixtures and Alterations installed in the Premises. Tenant shall provide Landlord with copies of any such warranties prior to the expiration of the Term (or, if the Lease is earlier terminated, within five (5) days thereafter).

22. MORTGAGEE RIGHTS

22.1 Subordination. Tenant's rights and interests under this Lease shall be (i) subject and subordinate to any ground lease, overleases, mortgage, deed of trust, or similar instrument covering the Premises, the Building and/or the Land and to all advances, modifications, renewals, replacements, and extensions thereof (each of the foregoing, a "**Mortgage**"), or (ii) if any Mortgagee elects, prior to the lien of any present or future Mortgage. Landlord shall obtain an SNDA, as hereinafter defined, from the holder of any future Mortgage which affects the Property. An "**SNDA**" shall be defined as a subordination, non-disturbance and attornment agreement on the standard form of SNDA then being used by the holder of the Mortgage in question, with such commercially reasonable modifications as may be requested by Tenant. Tenant further shall attorn to and recognize any successor landlord, whether through foreclosure or otherwise, as if the successor landlord were the originally named landlord. The provisions of this Section 22.1 shall be self-operative and no further instrument shall be required to effect such subordination or attornment; however, Tenant agrees to execute, acknowledge and deliver such instruments, confirming such subordination and attornment in such form as shall be requested by any such holder within fifteen (15) days of request therefor. Landlord represents that the Property is not encumbered by a Mortgage as of the date of this Lease.

22.2 Notices. Tenant shall give each Mortgagee the same notices given to Landlord concurrently with the notice to Landlord, and each Mortgagee shall have a reasonable opportunity thereafter to cure a Landlord default, and Mortgagee's curing of any of Landlord's default shall be treated as performance by Landlord.

22.3 Mortgagee Consent. Tenant acknowledges that, where applicable, any consent or approval hereafter given by Landlord may be subject to the further consent or approval of a Mortgagee; and the failure or refusal of such Mortgagee to give such consent or approval shall, notwithstanding anything to the contrary in this Lease contained, constitute reasonable justification for Landlord's withholding its consent or approval.

22.4 Mortgagee Liability. Tenant acknowledges and agrees that if any Mortgage shall be foreclosed, (a) the liability of the Mortgagee and its successors and assigns shall exist only so long as such Mortgagee or purchaser is the owner of the Premises, and such liability shall not continue or survive after further transfer of ownership; and (b) such Mortgagee and its successors or assigns shall not be (i) liable for any act or omission of any prior lessor under this Lease; (ii) liable for the performance of Landlord's covenants pursuant to the provisions of this Lease which arise and accrue prior to such entity succeeding to the interest of Landlord under this Lease or acquiring such right to possession; (iii) subject to any offsets or defense which Tenant may have at any time against Landlord; (iv) bound by any base rent or other sum which Tenant may have paid previously for more than one (1) month; or (v) liable for the performance of any covenant of Landlord under this Lease which is capable of performance only by the original Landlord.

23. QUIET ENJOYMENT.

Landlord covenants that so long as Tenant keeps and performs each and every covenant, agreement, term, provision and condition herein contained on the part and on behalf of Tenant to be kept and performed, Tenant shall peaceably and quietly hold, occupy and enjoy the Premises during the Term from and against the claims of all persons lawfully claiming by, through or under Landlord subject, nevertheless, to the covenants, agreements, terms, provisions and conditions of this Lease, any matters of record or of which Tenant has knowledge and to any Mortgage to which this Lease is subject and subordinate, as hereinabove set forth.

24. NOTICES.

Any notice, consent, request, bill, demand or statement hereunder (each, a "**Notice**") by either party to the other party shall be in writing and shall be deemed to have been duly given when either delivered by hand or by nationally recognized overnight courier (in either case with evidence of delivery or refusal thereof) addressed as follows:

If to Landlord:	HCP/King 75 Hayden LLC c/o King Street Properties 800 Boylston Street, Suite 1570 Boston, MA 02199 Attention: Stephen D. Lynch
With a copy to:	Goulston & Storrs PC 400 Atlantic Avenue Boston, MA 02110 Attention: King Street
if to Tenant:	Dicerna Pharmaceuticals, Inc. 33 Hayden Avenue Lexington, MA 02421

Attention: David W. Miller PhD, SVP

With a copy to:

Foley Hoag LLP
155 Seaport Boulevard
Boston, MA 02210
Attention: Real Estate Department

Notwithstanding the foregoing, any notice from Landlord to Tenant regarding ordinary business operations (e.g., exercise of a right of access to the Premises, maintenance activities, invoices, etc.) may also be given by written notice delivered to any person at the Premises whom Landlord reasonably believes is authorized to receive such notice on behalf of Tenant without copies as specified above. Either party may at any time change the address or specify an additional address for such Notices by delivering or mailing, as aforesaid, to the other party a notice stating the change and setting forth the changed or additional address, provided such changed or additional address is within the United States. Notices shall be effective upon the date of receipt or refusal thereof.

25. MISCELLANEOUS

25.1 Separability. If any provision of this Lease or portion of such provision or the application thereof to any person or circumstance is for any reason held invalid or unenforceable, the remainder of this Lease (or the remainder of such provision) and the application thereof to other persons or circumstances shall not be affected thereby.

25.2 Captions. The captions are inserted only as a matter of convenience and for reference, and in no way define, limit or describe the scope of this Lease nor the intent of any provisions thereof.

25.3 Broker. Tenant and Landlord each warrants and represents that it has dealt with no broker in connection with the consummation of this Lease other than T3 Advisors and JLL New England (collectively, "**Broker**"). Tenant and Landlord each agrees to defend, indemnify and save the other harmless from and against any Claims arising in breach of the representation and warranty set forth in the immediately preceding sentence. Landlord shall be solely responsible for the payment of any brokerage commissions to Broker.

25.4 Entire Agreement. This Lease, Lease Summary Sheet and Exhibits 1-12 attached hereto and incorporated herein contain the entire and only agreement between the parties and any and all statements and representations, written and oral, including previous correspondence and agreements between the parties hereto, are merged herein. Tenant acknowledges that all representations and statements upon which it relied in executing this Lease are contained herein and that Tenant in no way relied upon any other statements or representations, written or oral. This Lease may not be modified orally or in any manner other than by written agreement signed by the parties hereto.

25.5 Governing Law. This Lease is made pursuant to, and shall be governed by, and construed in accordance with, the laws of the Commonwealth of Massachusetts and any applicable local municipal rules, regulations, by-laws, ordinances and the like.

25.6 Representation of Authority. By his or her execution hereof, each of the signatories on behalf of the respective parties hereby warrants and represents to the other that he or she is duly authorized to execute this Lease on behalf of such party. Upon Landlord's request, Tenant shall provide Landlord with evidence that any requisite resolution, corporate authority and any other necessary consents have been duly adopted and obtained.

25.7 Expenses Incurred by Landlord Upon Tenant Requests.

(a) Tenant shall, upon demand, reimburse Landlord for all reasonable expenses, including, without limitation, legal fees, incurred by Landlord in connection with all requests by Tenant for consents, approvals or execution of collateral documentation related to this Lease, including, without limitation, costs incurred by Landlord in the review and approval of Tenant's plans and specifications in connection with proposed Alterations to be made by Tenant to the Premises or in connection with requests by Tenant for Landlord's consent to make a Transfer. Such costs shall be deemed to be additional rent under this Lease.

25.8 Survival. Without limiting any other obligation of Tenant which may survive the expiration or prior termination of the Term, all obligations on the part of Tenant to indemnify, defend, or hold Landlord harmless, as set forth in this Lease shall survive the expiration or prior termination of the Term.

25.9 Limitation of Liability. Tenant shall neither assert nor seek to enforce any claim against Landlord or any of the Landlord Parties, or the assets of any of the Landlord Parties, for breach of this Lease or otherwise, other than against Landlord's interest in the Building and in the uncollected rents, issues and profits thereof, and Tenant agrees to look solely to such interest for the satisfaction of any liability of Landlord under this Lease. This Section 25.9(a) shall not limit any right that Tenant might otherwise have to obtain injunctive relief against Landlord. **Landlord and Tenant specifically agree that in no event shall any officer, director, trustee, employee or representative of Landlord or any of the other Landlord Parties ever be personally liable for any obligation under this Lease, nor shall Landlord or any of the other Landlord Parties be liable for consequential or incidental damages or for lost profits whatsoever in connection with this Lease.**

25.10 Binding Effect. The covenants, agreements, terms, provisions and conditions of this Lease shall bind and benefit the successors and assigns of the parties hereto with the same effect as if mentioned in each instance where a party hereto is named or referred to, except that no violation of the provisions of Section 13 hereof shall operate to vest any rights in any successor or assignee of Tenant.

25.11 Landlord Obligations upon Transfer. Upon any sale, transfer or other disposition of the Building, Landlord shall be entirely freed and relieved from the performance and observance thereafter of all covenants and obligations hereunder on the part of Landlord to be performed and observed, it being understood and agreed in such event (and it shall be deemed and construed as a covenant running with the land) that the person succeeding to Landlord's ownership of said reversionary interest shall thereupon and thereafter assume, and perform and observe, any and all of such covenants and obligations of Landlord, except as otherwise agreed in writing.

25.12 No Grant of Interest. Tenant shall not grant any interest whatsoever in any fixtures within the Premises or any item paid in whole or in part by Landlord's Contribution or by Landlord.

25.13 Financial Information. Tenant shall deliver to Landlord, within thirty (30) days after Landlord's reasonable request, Tenant's most recently completed balance sheet and related statements of income, shareholder's equity and cash flows statements (audited if available) reviewed by an independent certified public accountant and certified by an officer of Tenant as being true and correct in all material respects. Any such financial information may be relied upon by any actual or potential lessor, purchaser, or mortgagee of the Property or any portion thereof. The Landlord acknowledges that Tenant is subject to the reporting obligations imposed on it pursuant to the Securities Exchange Act of 1934, as amended (the "**34 Act**"), and, as such, the Tenant's audited financial statements are readily available to the Landlord and the general public. Accordingly, Tenant shall not be obligated to provide Landlord with any of the information requested in this Section 25.13 for so long as Tenant is meeting its disclosure obligations under the 34 Act.

25.14 OFAC Certificate and Indemnity. Executive Order No. 13224 on Terrorist Financing, effective September 24, 2001 (the "Executive Order"), and the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001 (Public Law 10756, the "Patriot Act") prohibit certain property transfers. Tenant hereby represents and warrants to Landlord (which representations and warranties shall be deemed to be continuing and re-made at all times during the Term) that neither Tenant nor any stockholder, manager, beneficiary, partner, or principal of Tenant is subject to the Executive Order, that none of them is listed on the United States Department of the Treasury Office of Foreign Assets Control ("OFAC") list of "Specially Designated Nationals and Blocked Persons" as modified from time to time, and that none of them is otherwise subject to the provisions of the Executive Order or the Patriot Act, provided that so long as Tenant's shares of stock are publicly traded, Tenant makes no representation or warranty with respect to the ownership of any such shares of stock. The most current list of "Specially Designated Nationals and Blocked Persons" can be found at http://www.treas.gov/offices/eotffc/ofac/sdn/index.html. Tenant shall from time to time, within ten days after request by Landlord, deliver to Landlord any certification or other evidence requested from time to time by Landlord in its reasonable discretion, confirming Tenant's compliance with these provisions. No assignment or subletting, other than a Related Party Transfer, shall be effective unless and until the assignee or subtenant thereunder delivers to Landlord written confirmation of such party's compliance with the provisions of this subsection, in form and content satisfactory to Landlord. If for any reason the representations and warranties set forth in this subsection, or any certificate or other evidence of compliance delivered to Landlord hereunder, is untrue in any respect when made or delivered, or thereafter becomes untrue in any respect, then an event of default hereunder shall be deemed to occur immediately, and there shall be no opportunity to cure. Tenant shall indemnify, defend with counsel reasonably acceptable to Landlord, and hold Landlord harmless from and against, any and all liabilities, losses claims, damages, penalties, fines, and costs (including attorneys' fees and costs) arising from or related to the breach of any of the foregoing representations, warranties, and duties of Tenant. The provisions of this subsection shall survive the expiration or earlier termination of this Lease for the longest period permitted by law.

25.15 Confidentiality. Tenant acknowledges and agrees that the terms of this Lease are confidential. Disclosure of the terms hereof could adversely affect the ability of Landlord to negotiate other leases with respect to the Building and may impair Landlord's relationship with other tenants of the Building. Tenant agrees that it and its partners, officers, directors, employees, brokers, and attorneys, if any, shall not disclose the terms and conditions of this Lease to any other person or entity without the prior written consent of Landlord which may be given or withheld by Landlord, in Landlord's sole discretion, except as required for financial disclosures or securities filings, as required by the order of any court or public body with authority over Tenant, or in connection with any litigation between Landlord and Tenant with respect this Lease. It is understood and agreed that damages alone would be an inadequate remedy for the breach of this provision by Tenant, and Landlord shall also have the right to seek specific performance of this provision and to seek injunctive relief to prevent its breach or continued breach. Notwithstanding the foregoing, Landlord understands and acknowledges that Tenant is required to publicly disclose this Lease as a material agreement under the 34 Act and that making such required disclosure does not and shall not result in a breach of this Section 25.15 by Tenant.

25.16 Force Majeure. Other than for Tenant's obligations under this Lease that can be performed by the payment of money (e.g., payment of Rent and maintenance of insurance), whenever a period of time is herein prescribed for action to be taken by either party hereto, such party shall not be liable or responsible for, and there shall be excluded from the computation of any such period of time, any delays due to strikes, riots, acts of God, shortages of labor or materials, war, acts of terrorism, governmental laws, regulations, or restrictions, or any other causes of any kind whatsoever which are beyond the control of such party (collectively "**Force Majeure**"). In no event shall financial inability of a party be deemed to be Force Majeure.

25.17 Right of First Offer.

(a) Grant of Option; Conditions. Tenant shall have the one time right of first offer (the "**Right of First Offer**") with respect to any available space on the third (3rd) floor of the Building (the "**Offering Space**"). Notwithstanding anything to the contrary contained herein, no portion of the Offering Space shall be deemed available until each such portion of the Offering Space has been leased to a third party and thereafter Landlord determines that such third party tenant of such Offering Space will vacate such Offering Space. Tenant's Right of First Offer shall be exercised, if at all, as follows: at any time after Landlord has determined that the existing tenant in the Offering Space will not extend or renew the term of its lease for the Offering Space (but prior to leasing such Offering Space to a party other than the existing tenant), Landlord shall advise Tenant (the "**Advice**") of the terms under which Landlord is prepared to lease the Offering Space to Tenant for the remainder of the Term, which terms shall reflect the Prevailing Market (hereinafter defined) rate for such Offering Space as reasonably determined by Landlord. Tenant may lease such Offering Space in its entirety only, under such terms, by delivering written notice of exercise to Landlord (the "**Notice of Exercise**") within 10 business days after the date of the Advice, except that Tenant shall have no such Right of First Offer and Landlord need not provide Tenant with an Advice, if:

(i) Tenant is in default under the Lease beyond any applicable cure periods at the time that Landlord would otherwise deliver the Advice; or

(ii) the Premises, or any portion thereof, is sublet (other than pursuant to a Transfer, as defined in Article 13 of the Lease) at the time Landlord would otherwise deliver the Advice; or

(iii) the Lease has been assigned (other than pursuant to a Transfer described in Section 13.7 above) prior to the date Landlord would otherwise deliver the Advice; or

(iv) Tenant is not occupying 60% or more of the Premises on the date Landlord would otherwise deliver the Advice; or

(v) the Offering Space is not intended for the exclusive use of Tenant during the Term; or

(vi) the existing tenant in the Offering Space is interested in extending or renewing its lease for the Offering Space or entering into a new lease for such Offering Space.

(b) Terms for Offering Space.

(i) The term for the Offering Space shall commence upon the commencement date stated in the Advice and thereupon such Offering Space shall be considered a part of the Premises, provided that all of the terms stated in the Advice shall govern Tenant's leasing of the Offering Space and only to the extent that they do not conflict with the Advice, the terms and conditions of this Lease shall apply to the Offering Space.

(ii) Tenant shall pay Base Rent and additional rent for the Offering Space in accordance with the terms and conditions of the Advice, which terms and conditions shall reflect the Prevailing Market rate for the Offering Space as determined in Landlord's reasonable judgment; provided, however, that in no event shall the Base Rent and additional rent be less than the Base Rent and additional rent Tenant is then paying for the Premises.

(iii) The Offering Space (including improvements and personalty, if any) shall be accepted by Tenant in its condition and as-built configuration existing on the earlier of the date Tenant takes possession of the Offering Space or as of the date the term for such Offering Space commences, unless the Advice specifies any work to be performed by Landlord in the Offering Space, in which case Landlord shall perform such work in the Offering Space. If Landlord is delayed in delivering possession of the Offering Space due to the holdover or unlawful possession of such space by any party, Landlord shall use reasonable efforts to obtain possession of the space, and the commencement of the term for the Offering Space shall be postponed until the date Landlord delivers possession of the Offering Space to Tenant free from occupancy by any party.

(c) Termination of Right of First Offer. The rights of Tenant hereunder with respect to the Offering Space shall terminate on the earlier to occur of: (i) the date that is two (2) years before the Expiration Date (unless Tenant simultaneously exercises its right, if any, to extend the Term as set forth in Section 1.2 above)**;** (ii) Tenant's failure to exercise its Right of First Offer within the 5-day period provided in Section A above; and (iii) the date Landlord would have

provided Tenant an Advice if Tenant had not been in violation of one or more of the conditions set forth in Section A above.

(d) Offering Amendment. If Tenant exercises its Right of First Offer, Landlord shall prepare an amendment (the "**Offering Amendment**") adding the Offering Space to the Premises on the terms set forth in the Advice and reflecting the changes in the Base Rent, Rentable Square Footage of the Premises, Tenant's Pro Rata Share and other appropriate terms. A copy of the Offering Amendment shall be sent to Tenant within a reasonable time after Landlord's receipt of the Notice of Exercise executed by Tenant, and Tenant shall execute and return the Offering Amendment to Landlord within 10 business days thereafter, but an otherwise valid exercise of the Right of First Offer shall be fully effective whether or not the Offering Amendment is executed.

(e) Definition of Prevailing Market. For purposes of this Right of First Offer provision, "**Prevailing Market**" shall mean the annual rental rate per square foot for space comparable to the Offering Space in the Building and combination laboratory and office buildings comparable to the Building in the Market Area (as defined in Section 1.2(b)) under leases and renewal and expansion amendments being entered into at or about the time that Prevailing Market is being determined, giving appropriate consideration to tenant concessions, brokerage commissions, tenant improvement allowances, existing improvements in the space in question, and the method of allocating operating expenses and taxes. Notwithstanding the foregoing, space leased under any of the following circumstances shall not be considered to be comparable for purposes hereof: (i) the lease term is for less than the lease term of the Offering Space, (ii) the space is encumbered by the option rights of another tenant, or (iii) the space has a lack of windows and/or an awkward or unusual shape or configuration. In no event shall the Prevailing Market rate be lower than the per square foot rate that Tenant is paying for the original Premises**.** The foregoing is not intended to be an exclusive list of space that will not be considered to be comparable.

[SIGNATURES ON FOLLOWING PAGE]

IN WITNESS WHEREOF the parties hereto have executed this Lease as a sealed instrument as of the Execution Date.

LANDLORD

HCP/KING 75 HAYDEN LLC,
a Delaware limited liability company

By: King Mattingly LLC, a Massachusetts limited liability company, its Manager

By: King Street Properties Investments LLC, a Massachusetts limited liability company, its Manager

By: /s/ Stephen D. Lynch

Name: Stephen D. Lynch · Its Manager

TENANT

DICERNA PHARMACEUTICALS, INC.,

By: /s/ John B. Green

Name: John B. Green · Title: Chief Financial Officer

EXHIBIT 1A

LEASE PLAN – PRIME PREMISES – 4TH FLOOR

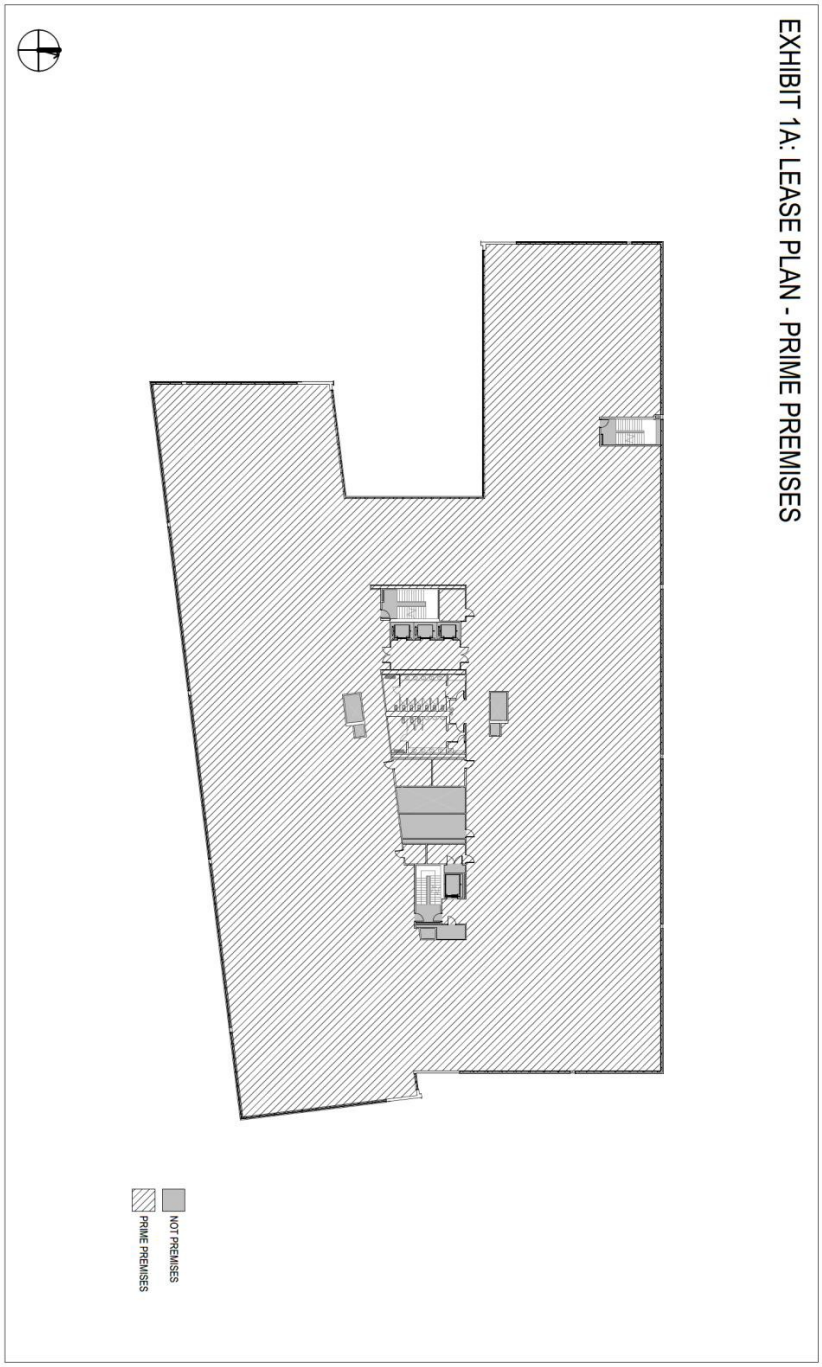


EXHIBIT 1B

LEASE PLAN – PH SYSTEM PREMISES – 1ST FLOOR

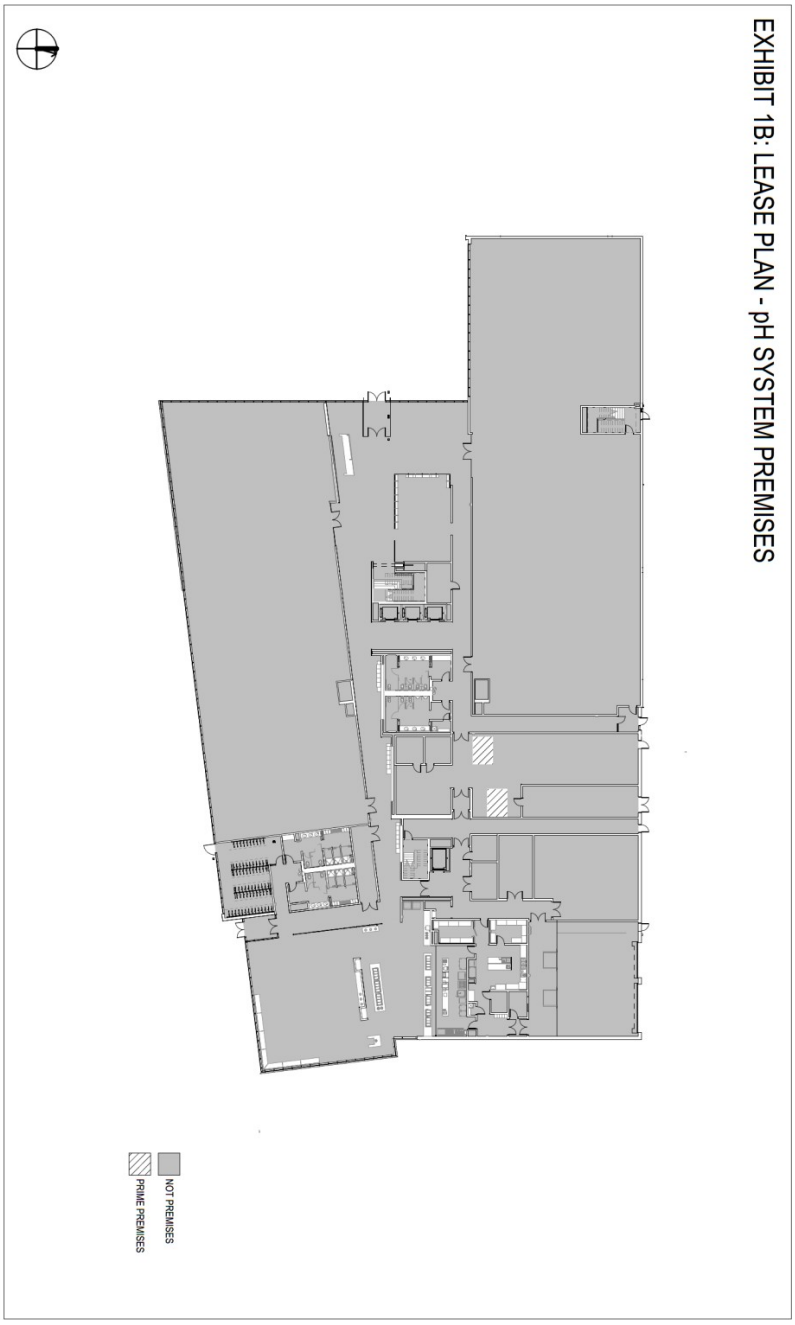


EXHIBIT 1C

LEASE PLAN –STORAGE PREMISES – 1ST FLOOR

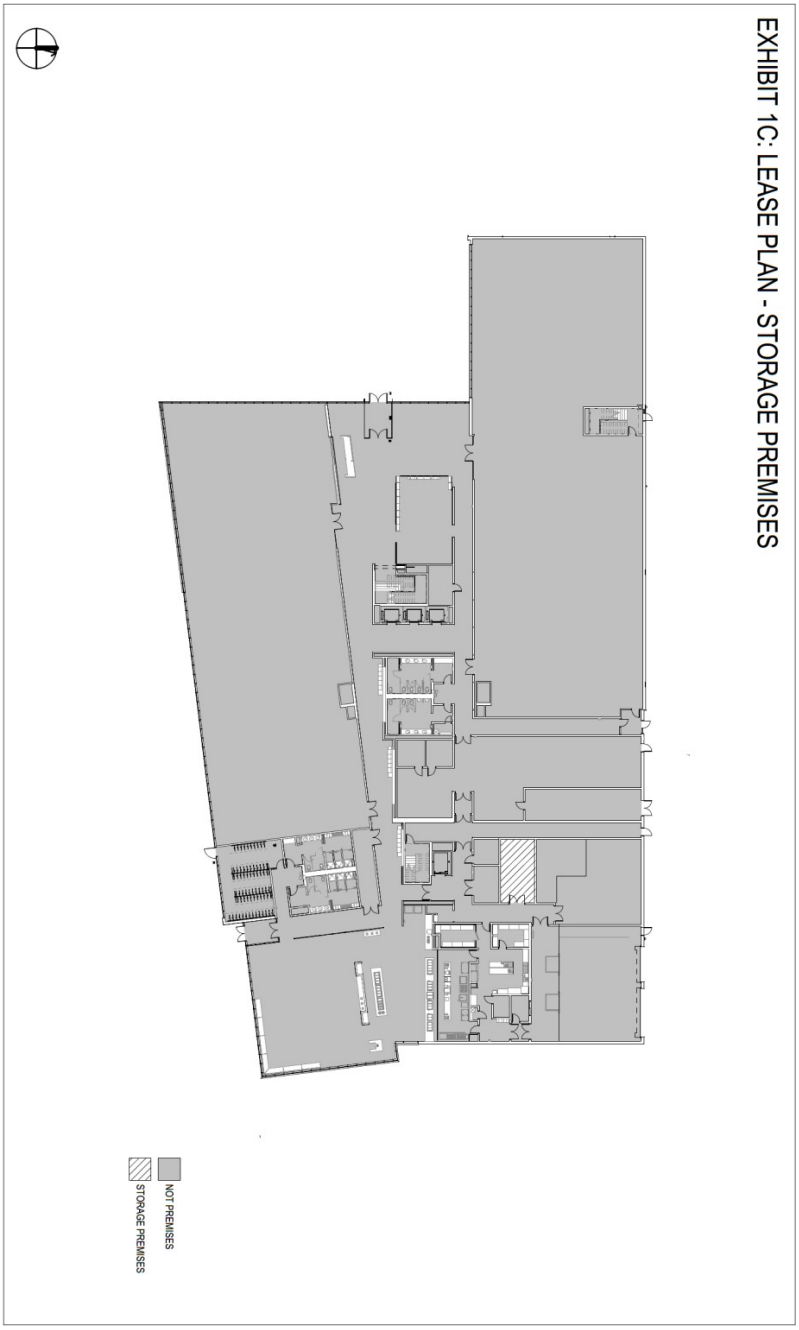
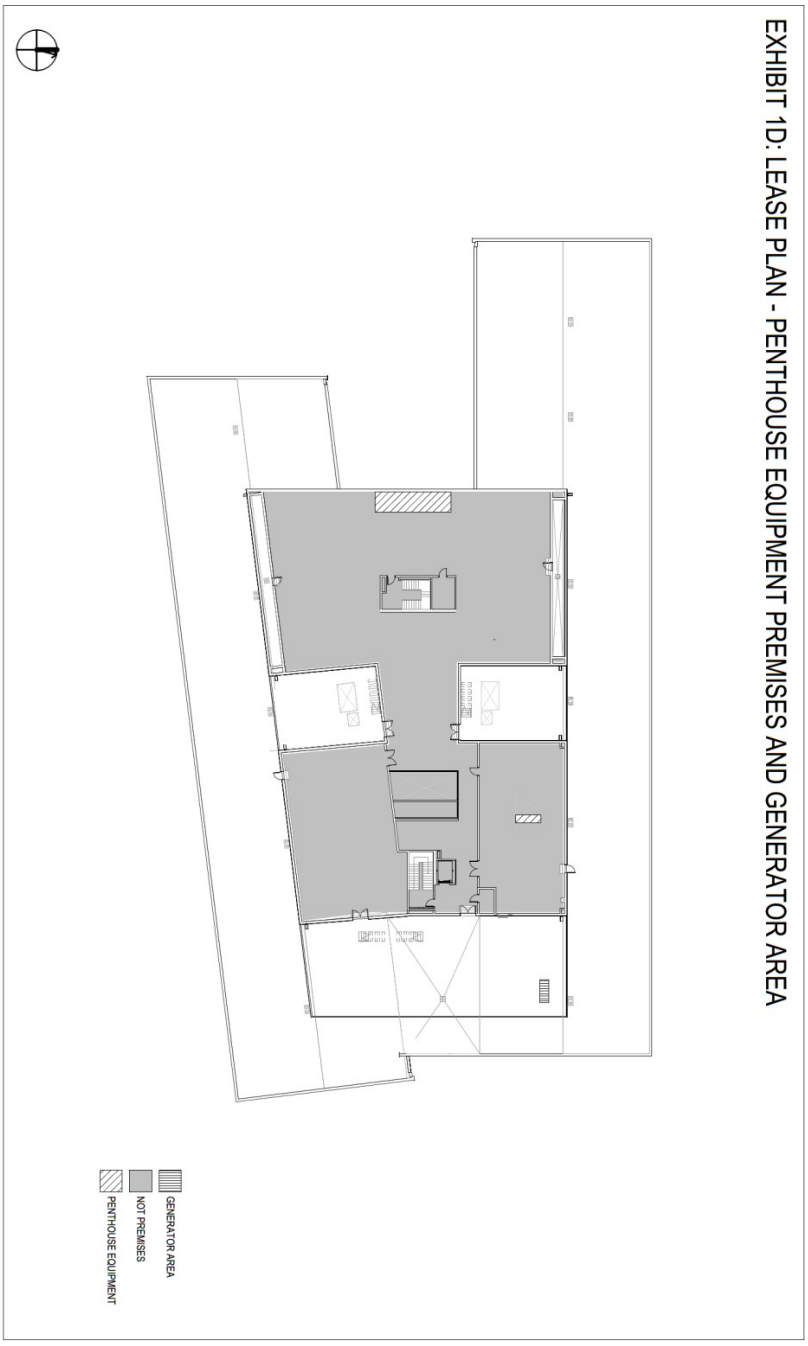


EXHIBIT 1D

LEASE PLAN – PENTHOUSE EQUIPMENT PREMISES AND GENERATOR AREA



Building 75:

EXHIBIT 2A

LEGAL DESCRIPTION - LAND

A certain portion of land in the Town of Lexington, Middlesex County, and Commonwealth of Massachusetts, being shown as “Expansion Unit Development Area = 286,017 Square Feet 6.566+/- Acres on a plan entitled, “The Hayden Science Center Condominium, Condominium Site Plan,” dated April 4, 2017, by Feldman Land Surveyors, (the “Plan”),and being more particularly described as follows:

Commencing at the northwesterly corner of Parcel One, also being the northeasterly corner of Parcel Three, (being shown on the Plan as “POC-E”);

thence running S 02°20’56” W, a distance of 76.99 feet to a point;

thence turning and running N 87°03’28” W, a distance of 12.00 feet to the point of beginning (being shown on the Plan as “POB-E”);

thence turning and running S 87°03’28” E, a distance of 693.77 feet to a point of curvature;

thence running along a curve to the right having a radius of 310.00 feet, an arc length of 466.24 feet, a chord bearing of S 43°58’17” E, and a chord distance of 423.52 feet to a point;

thence turning and running N 87°39’04” W, a distance of 661.94 feet to a point; thence turning and running S 28°10’16” W, a

distance of 38.74 feet to a point; thence turning and running N 87°39’04” W, a distance of 321.21 feet to a point;

thence turning and running N 02°20’56” E, a distance of 334.55 feet to the point of beginning. Said portion of land contains an area of 286,017 square feet, or 6.566 acres, more or less.

EXHIBIT 2B LEGAL DESCRIPTION

Real property in the Town of Lexington, County of Middlesex, Commonwealth of Massachusetts, described as follows:

Parcel One (45 & 55 Hayden Avenue):

A certain parcel of land in the Commonwealth of Massachusetts, County of Middlesex, Town of Lexington, and shown as Lot 2 on a plan entitled “Plan of Land in Lexington, Mass. (Middlesex County),” dated March 27, 1998, recorded October 6, 1998, with Middlesex South Registry of Deeds as Plan No. 1088 of 1998 in Book 29190, Page 447, prepared by Beals and Thomas, Inc., more particularly bounded and described as follows:

Beginning at the most southwesterly corner of the premises, at the southeasterly corner of Lot 1 as shown on said plan, then running:

N 02° 20’ 56” E 180.68 feet to a point, thence turning and running; N 87° 39” 04” W 40.00 feet to a point, thence turning and running; N 02° 20’ 56” E 122.19 feet to a point, thence turning and running; N 87° 39’ 04” E 40.00 feet to a point, thence turning and running;

N 02° 20’ 56” E 547.13 feet to a point, thence turning and running, said last five courses being bounded by Lot 1, as shown on said plan, thence turning and running;

S 87° 36’ 20” E 1,330.04 feet to a point of curvature, thence running;

Northeasterly to a curve to the left having a radius of 135.00 feet and a length of 58.90 feet to a point of tangency, thence running;

N 67° 23’ 52” E 146.89 feet to a point, thence turning and running;

S 03° 52’ 06” E 111.25 feet to a point, said last four courses being bounded by land now or formerly of the Town of Lexington, thence turning and running;

S 44° 07’ 54 W 561.19 feet to a point, thence turning and running;

S 22° 29’ 38” E 435.76 feet to a point, said last two courses are bounded in part by land now or formerly the Town of Lexington and, in part now or formerly of Hayden Office Trust, thence running;

Southwesterly by a curve to the right, having a radius of 985.00 feet and a length of 12.11 feet to a point of tangency, thence turning and running;

N 87° 36’ 20” W 1,329.27 feet to the point of beginning, said last two courses being bounded by the northerly sideline of Hayden Avenue.

Containing 1,123,722 square feet more or less, or 25.797 acres, more or less. A portion of said Lot 2 is registered land, described

as follows:

Lot 293 on Land Court Plan 19485 N as approved by the Land Court and filed in the Land Registration Office; and

Lots 10 and 11 on Land Court Plan 16660 O as approved by the Land Court and filed with the Land Registration Office.

Parcel Two (Appurtenant Easements - 45 & 55 Hayden Avenue):

A. There is appurtenant to the above described Lot 11 the right and easement to use the drainage ditch running from west to east across the northerly portion of Lot 10, shown on said plan, as set forth in Registered Document No. 517903.

B. There is appurtenant to the above described Lot 11 rights and easements for sewer purposes as set forth in Registered Document No. 479201.

C. There is appurtenant to said Lot 293 the benefits of the agreement and reservation as to trunk sewer more particularly set forth in deed filed as Document No. 479738.

D. Lot 10 has the benefit of a reservation in the strip of land marked sewer easement as shown on said plan, set forth in Document 517903 and the rights and easements for sewer purposes as set forth in Registered Document No. 479201, insofar as applicable.

E. Together with the benefit of the appurtenant easements over Lot B shown on plan entitled “A Compiled Plan of Land in Lexington, Mass.” Dated August 27, 1970, by John J. McSweeney, recorded with Middlesex South District Deeds in Book 11928, Page 614, as shown on said plan, as reserved in a taking by the Town of Lexington dated November 30, 1970, recorded with said Deeds in Book 11928, Page 611, and in a deed from George H. Crawford to the Town of Lexington of the said Lot B dated December 7, 1970, recorded with said Deeds in Book 11928, Page 614.

F. Together with the benefit of the appurtenant easements set forth in Declaration of Covenants and Easements dated September 18, 1998 filed as Document No. 1084070 and recorded in Book 29287, Page 189; as affected by Amended and Restated Declaration of Covenants and Easements dated November 8, 1999, filed as Document No. 1123738, and recorded in Book 30855, Page 323; as affected by First Amendment to Amended and Restated Declaration of Covenants and Easements dated March 26, 2002, filed as Document No. 1261521, recorded in Book 37256, Page 364.

Parcel Three (65 Hayden Avenue):

That certain parcel of land situate in Lexington in the County of Middlesex and Commonwealth of Massachusetts shown as Lot 292 on Land Court Plan No. 19485-N.

All of said boundaries are determined by the Court to be located as shown on a subdivision plan, as approved by the Court, filed in the Land Registration Office, a copy of which is filed in the Registry of Deeds for the South Registry District of Middlesex County in Registration Book 1178 Page 11.

Parcel Four (Appurtenant Easements - 65 Hayden Avenue):

There is appurtenant to said Lot 292 the right to use the whole of Grassland Street and Valleyfield Street as shown on the plan Registered in the Registration Book 383 Page 149 in common with others entitled thereto; the right to use all streets or roads as shown on the plan Registered in Registration Book 506 Page 153, in common with all others legally entitled thereto; the benefit of the agreement and reservation as to trunk sewer more particularly set forth in the deed Registered as Document No. 479738; and the benefit of the appurtenant easements set forth in Declaration of Covenants and Easements dated September 18, 1998 filed as Document No. 1084070 and recorded in Book 29287, Page 189; as affected by Amended and Restated Declaration of Covenants and Easements dated November 8, 1999, filed as Document No. 1123738, and recorded in Book 30855, Page 323; as affected by First Amendment to Amended and Restated Declaration of Covenants and Easements dated March 26, 2002, filed as Document No. 1261521, recorded in Book 37256, Page 364.

EXHIBIT 3 PARKING AREAS

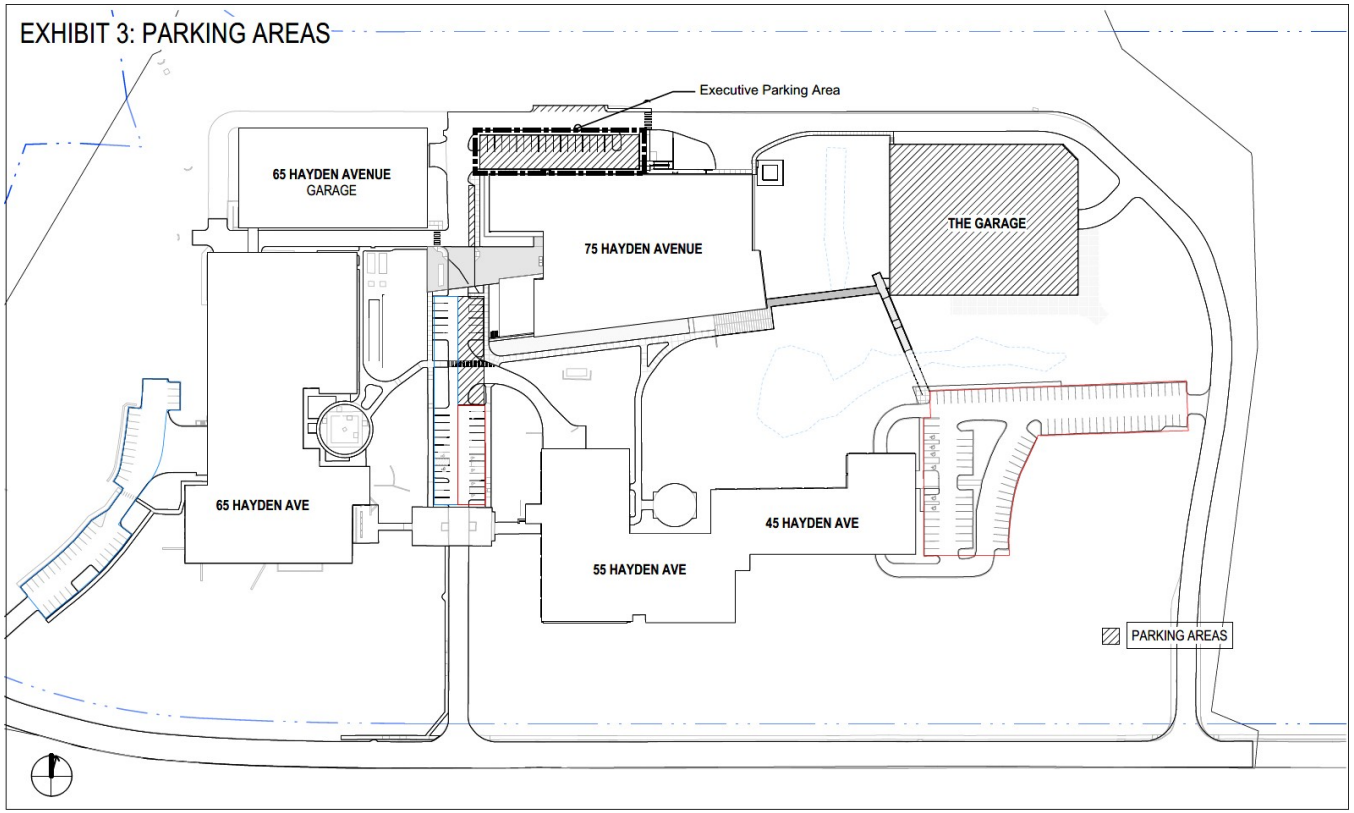


EXHIBIT 4 WORK LETTER

This Exhibit is attached to and made a part of the Lease (the "**Lease**") by and between **HCP/KING 75 HAYDEN LLC**, a Delaware limited liability company ("**Landlord**"), and **DICERNA PHARMACEUTICALS, INC.**, a Delaware corporation ("**Tenant**"), for space located at 75 Hayden Avenue, Lexington, Massachusetts. Capitalized terms used but not defined herein shall have the meanings given in the Lease.

This Work Letter shall set forth the obligations of Landlord and Tenant with respect to the improvements to be performed in preparing the Premises for Tenant's use. This Exhibit shall not be deemed applicable to any additional space added to the Premises at any time or from time to time, whether by any options under the Lease or otherwise, or to any portion of the original Premises or any additions to the Premises in the event of a renewal or extension of the original Term of the Lease, whether by any options under the Lease or otherwise, unless expressly so provided in the Lease or any amendment or supplement to the Lease.

1. Definitions.

(a) This Work Letter shall set forth the obligations of Landlord and Tenant with respect to the improvements to be performed in the Premises for Tenant's use. For the purposes of this Lease, "**Landlord's Work**" consists of: (i) the Base Building Work described on Exhibit 4-1, which shall be completed as Landlord's sole cost and expense, (ii) the Tenant Improvement Work, as hereinafter defined, and (iii) the Landlord's Kitchen Work, as hereinafter defined, which along with the Tenant Improvement Work shall be completed at Landlord's cost but subject to Landlord's Contribution, as hereinafter defined; and "**Tenant's Work**" consists of the construction and/or installation, at Tenant's sole cost and expense, all of Tenant's furniture, fixtures and equipment, Tenant's Security System Work, all telephone and data wiring throughout the Premises, and other equipment Tenant intends to install in connection with the initial preparation of the Premises for Tenant's occupancy (including, without limitation, any equipment, alarms, audio visual equipment and wiring, white noise equipment and wiring, and UPS). A matrix specifying the responsibility and schedule for the performance of the Landlord's Work and Tenant's Work is attached hereto as Exhibit 4-2. The "**Tenant Improvement Work**" consists of the items listed on Exhibit 4-2 (Tenant/Landlord Responsibility Matrix) as "Landlord" (except to the extent included in the Base Building Work). Without limiting the generality of the foregoing, the Tenant Improvement Work does not include the Landlord's Kitchen Work. The parties intend that Tenant Improvement Work will be in accordance with construction documents (the "**Construction Documents**") prepared by Landlord and approved by Tenant in accordance with this Exhibit 4 (which Construction Documents shall include sufficient detail with respect to finishes selected by Tenant and engineering of the mechanical, electrical, and plumbing systems to be completed by the Contractor so as to be submitted for a building permit). The Construction Documents shall be based upon a space plan and design development plans to be prepared by Tenant (collectively, the "**DD Plans**"), which DD Plans shall be delivered to Landlord on or before February 1, 2020. A schematic plan showing the general layout of the Tenant Improvement Work is attached hereto as Exhibit 4-3; the DD Plans are anticipated to be materially consistent with the schematic plan attached hereto as Exhibit 4-3.

(b) The "**Landlord's Kitchen Work**" consists of the construction of a commissary kitchen within the Premises (the "**Kitchen**"), based on design plans ("**Kitchen DD Plans**") to be prepared by Tenant and submitted to Landlord for its approval (said approval not to be unreasonably withheld, conditioned or delayed). The Landlord's Kitchen Work will be performed by Landlord based on a mutually agreeable timeline and schedule to be jointly determined by Landlord and Tenant following approval of the Kitchen DD Plans, provided that Landlord and Tenant acknowledge and agree that the performance of the Landlord's Kitchen Work shall be separate and distinct from Landlord's performance of the Tenant Improvement Work, and that such timeline and schedule for the Landlord's Kitchen Work may provide for the Landlord's Kitchen Work to commence after the Substantial Completion of the Tenant Improvement Work; provided, however, (i) Landlord shall use reasonable and diligent efforts to complete the Landlord's Kitchen Work on the mutually agreed upon timeline, (ii) portions of Landlord's Kitchen Work may be performed concurrently with the Tenant Improvement Work, in Landlord's discretion; and (iii) Landlord's performance of the Landlord's Kitchen Work after the Term Commencement Date shall be performed in a manner so as to minimize interference with Tenant's use of the balance of the Premises (including, performing any noisy, dusty or other disruptive work outside Tenant's normal business hours). Upon Landlord's approval of the Kitchen DD Plans for the Landlord's Kitchen Work, Landlord shall prepare and Tenant shall approve construction documents for the Landlord's Kitchen Work (the "**Kitchen CDs**") in the same manner as applicable to the Tenant Improvement Work.

(c) Landlord agrees to reimburse Tenant up to $9,192.30 (the "**Space Planning Allowance**") for the preparation of the DD Plans and the Kitchen DD Plans, and any unused portion of the Space Planning Allowance shall be added to the Landlord's Contribution (as defined below). Landlord and Tenant acknowledge that the Construction Documents have not yet been prepared and, therefore, it is impossible to determine the exact cost of the Tenant Improvement Work at this time. Accordingly, Landlord and Tenant agree that Landlord's obligation to pay for the Cost of Tenant Improvement Work, as hereinafter defined shall be limited to an amount ("**Landlord's Contribution**") which shall not exceed $6,128,200 (i.e., $100.00 per rentable square foot of the Premises) (the "**Maximum Amount**") and that Tenant shall be responsible for the Cost of Tenant Improvement Work to the extent that it exceeds the Maximum Amount. The "**Cost of Tenant Improvement Work**" shall be defined as all hard costs ("**Hard Costs**") incurred by Landlord relating to the performance of the Tenant Improvement Work and the Landlord's Kitchen Work, collectively (including, without limitation, the cost of obtaining permits and any applicable state sales and use taxes) and soft costs ("**Soft Costs**") incurred by Landlord in connection with the Tenant Improvement Work and the Landlord's Kitchen Work, collectively (including, without limitation, the cost of preparing the DD Plans, the Construction Documents and the Kitchen CDs). For avoidance of doubt, and without limiting the generality of the foregoing, the Cost of Tenant Improvement Work shall not include the costs of the Tenant's Work or other costs and fees incurred by Tenant in connection with the preparation of the Premises for Tenant's initial occupancy (including, without limitation, consulting fees). Landlord will charge Tenant a construction management fee equal to 2.5% of all Hard Costs payable by Tenant in connection with the Tenant Improvement Work and the Landlord's Kitchen Work, collectively. Landlord shall be solely responsible for the costs to construct the Base Building Work.

2. Contractor; GMP. Landlord shall enter into one or more contracts (each, a "**Contract**") for the Tenant Improvement Work and the Landlord's Kitchen Work with B.W.

Kennedy & Company, LLC ("**Contractor**"). The Contracts shall be on the basis of a guaranteed maximum price ("**GMP**"). The GMP shall be determined based upon the sum of the following:

- Contractor's Fee: 3% of the sum ("**Cost of the Work**") of: (i) Direct Cost of the Work, and (ii) General Conditions Costs (as established by the Contract).
- Direct Cost of the Work: Determined by bids obtained from subcontractors in accordance with Section 5 below.
- Contingency: 5% of the Cost of the Work.

3. Preparation of Construction Documents. The Contractor and/or Landlord shall engage R.E. Dinneen Architects & Planners, Inc. and B.W. Kennedy & Company, LLC as subconsultants to prepare the Construction Documents and Kitchen CDs for Tenant's approval, which approval shall not be unreasonably withheld, conditioned, or delayed.

4. Tenant Responses. Tenant shall respond, in writing, to any requests from Landlord or the Contractor for information, consents, or authorizations to proceed, within four (4) business days of Tenant's receipt of such request. Any failure by Tenant to respond within such time period may be the basis of a Tenant Delay. Tenant shall have the right to hire a mutually approved Tenant Construction Representative to oversee all required construction relative to the Tenant Premises.

5. Bid Process. Tenant hereby acknowledges that:

(i) the Contractor will receive a single bid for each of the following portions of Landlord's Work from the designated subcontractors ("**Designated Subcontractors**") listed below who will perform both the design and construction such portions of Landlord's Work:

- Mechanical/HVAC: Environmental Systems, Inc.
- Plumbing: North Shore Mechanical Contractors, Inc.
- Fire Protection: Legacy Fire Protection, Inc.
- Electrical: Nappa Electrical Contractors

If requested by Tenant, Landlord will cause any Designated Subcontractor to provide backup documentation with respect to its bid, reasonably demonstrating that its bid is competitively priced relative to similarly situated subcontractors working in the Route 128/Route 2/Alewife corridor real estate market.

(ii) Landlord will cause the Contractor to use reasonable efforts to obtain at least three (3) bidders for other portions of Landlord's Work; however, given the current market, it may not be possible to obtain more than one or two bidders with respect to portions of Landlord's Work.

If Tenant reasonably determines that the GMP is higher than is acceptable to Tenant, then Tenant shall have a one-time right to give request changes for each of the Tenant Improvement Work and the Landlord's Kitchen Work, as applicable. In order to exercise such one-time right to request changes for each of the Tenant Improvement Work and the Landlord's Kitchen Work, as applicable in order to reduce the GMP with respect to Tenant Improvement Work or the Landlord's

Kitchen Work, as applicable, Tenant shall, on or before the date five (5) business days after Tenant receives Landlord's notice to Tenant of the applicable GMP, give written notice to Landlord specifying the changes in the Tenant Improvement Work or the Landlord's Kitchen Work, as applicable, requested by Tenant. Such changes shall be subject to Landlord's prior written approval (which approval shall not be unreasonably withheld, conditioned, or delayed). Based upon the revised Construction Documents for the Tenant Improvement Work, and/or the revised Kitchen CDs for the Landlord's Kitchen Work, which are based upon the changes requested by Tenant, as approved by Landlord, as aforesaid, the Contractor shall revise the applicable GMP for the construction of the Tenant Improvement Work or Landlord's Kitchen Work, as applicable, in accordance with this Section 5. Tenant shall be responsible for the design cost associated with the preparation of the revised Construction Documents or Kitchen CDs, as applicable. Tenant shall have the right to review the applicable revised GMP within five (5) business days after receipt thereof.

6. Tenant's Share. For the purposes of this Exhibit 4: (i) if the Cost of Tenant Improvement Work is equal to, or less than, the Maximum Amount, then "**Tenant's Construction Share**" shall be 0%, or (ii) if the Cost of Tenant Improvement Work is greater than the Maximum Amount, then Tenant's Construction Share shall be a fraction, the numerator of which is the amount by which the total Cost of Tenant Improvement Work exceeds the Maximum Amount and the denominator of which is the total Cost of Tenant Improvement Work. Following Substantial Completion of the Tenant Improvement Work and Landlord's Kitchen Work, Landlord will provide Tenant with documentation demonstrating the final Cost of Tenant Improvement Work, which documentation shall consist of copies of the requisitions from the Contractor and invoices from vendors and consultants not otherwise included in the requisitions.

7. Tenant's Obligation to Pay. If the Cost of Tenant Improvement Work exceeds the Maximum Amount, Tenant shall pay to Landlord such excess costs as follows: (i) Tenant shall pay Tenant's Share of Tenant Improvement Costs within thirty (30) days of Billing, as hereinafter defined, (ii) with respect to any Changes to the Tenant Improvement Work, Tenant shall pay for the cost of such changes in accordance with Section 8 below, and (iii) with respect to any increases in the Cost of Tenant Improvement Work arising from Claims by the Contractor, Tenant shall pay for the cost of such Claims as set forth in Section 9 below. "**Billing**" shall be defined as any invoice from Landlord setting forth, reasonable detail, the amount due from Tenant, and shall include invoices from vendors and service providers, and applications for payment from the Contractor for work completed through the date of Billing, as certified by the Contractor. Billing may not be submitted to Tenant more than one time per calendar month. The amounts payable by Tenant hereunder constitute Rent payable pursuant to the Lease, and the failure to timely pay same constitutes an Event of Default under the Lease.

8. Changes. If Tenant shall request any change, addition or alteration in any of the Construction Documents and/or Kitchen CD's after approval by Landlord ("**Changes**"), Landlord shall diligently prepare revisions to the drawings consistent with Tenant's request. Promptly upon completion of the revisions, Landlord shall notify Tenant in writing of the increased cost, if any, which will be chargeable to Tenant by reason of such change, addition or deletion. Tenant, within three (3) business days, shall notify Landlord in writing whether it desires to proceed with such Change. In the absence of such written authorization, Landlord shall have the option to continue work on the Premises disregarding the requested Change. To the extent that the cost of performing

such revisions cause the Cost of Tenant Improvement Work to exceed the Maximum Amount, Tenant shall reimburse Landlord for the such excess in the Cost of Tenant Improvement Work associated with such Changes within thirty (30) days of approving the Changes.

9. Claims. To the extent that any claims ("**Claims**") by the Contractor cause the Cost of Tenant Improvement Work to exceed the Maximum Amount, Tenant shall pay for such excess within thirty (30) days of Billing. Claims shall include any amounts properly due to the Contractor under the Contract based upon the claims of the Contractor under the Contract, provided however, that the Claims shall not include any amounts arising from the default or negligence of Landlord, or Landlord's agents or employees, under the Contract.

10. Performance of Landlord's Work. Following approval of the Construction Documents and Tenant's written authorization to proceed with Tenant Improvement Work, Landlord shall cause the Tenant Improvement Work to be constructed in a good and workmanlike manner in compliance with applicable Legal Requirements and, in all material respects, in accordance with the approved Construction Documents. Following approval of the Kitchen CDs and Tenant's written authorization to proceed with the Landlord's Kitchen Work, Landlord shall cause the Landlord's Kitchen Work to be constructed in a good and workmanlike manner, based on the agreed-upon construction timeline, in compliance with applicable Legal Requirements and, in all material respects, in accordance with the approved Kitchen CDs.

11. Landlord's Contribution:

a. Except as set forth in this Section 11, any portion of Landlord's Contribution which exceeds the Cost of Tenant Improvement Work (the "**Remaining Portion of Landlord's Contribution**") shall accrue to the sole benefit of Landlord, it being agreed that Tenant shall not be entitled to any credit, offset, abatement or payment with respect thereto.

b. Requisitions. If there is any Remaining Portion of Landlord's Contribution, Tenant may submit Requisitions, as hereinafter defined, to Landlord to pay for the costs (collectively, "**Other Permitted Costs**") for Tenant's Security System Work, telephone and data wiring throughout the Premises and reasonable fees for Tenant's third-party project manager, as follows:

(1) A "**Requisition**" shall mean (1) an application for payment (accompanied by, without limitation, invoices from Tenant's contractors, vendors, service providers and consultants (collectively, "**Tenant's Contractors**") listing in reasonable detail Other Permitted Costs, (2) a certification executed by an authorized representative of Tenant that the amount of the Requisition in question does not exceed the cost of the items, services and work covered by such Requisition, and (3) only with respect to those items and services covered by such Requisition for which mechanic's lien rights arise under Massachusetts Law, partial lien waivers and subordinations of lien, as specified in M.G.L. Chapter 254, Section 32 ("**Lien Waivers**"). Landlord shall have the right, upon reasonable advance notice to Tenant, to inspect Tenant's books and records relating to each Requisition in order to verify the amount thereof. Tenant shall submit Requisition(s) no more often than monthly.

(2) On the condition that Tenant is not in default of its obligations under the Lease at the time that Landlord receives a Requisition, Landlord shall pay the amount properly due under such Requisition with forty-five (45) days of receipt of such Requisition. Notwithstanding the foregoing, if Landlord declines to pay Tenant on account of any Requisition based upon Tenant then being in default of its obligations under the Lease, and if Tenant subsequently cures such default, then Tenant shall have the right to resubmit such Requisition, and Landlord shall pay the amount due on account of such Requisition, provided that the Lease is then in full force and effect and all of the conditions to payment on account of such Requisition are then satisfied.

(3) Notwithstanding anything to the contrary herein contained: (i) Landlord shall have no obligation to advance funds on account of Landlord's Contribution more than once per month; (ii) if any Tenant's Contractor (including subcontractors of any tier, or materialman) records a Notice of Contract which is not discharged or bonded over by, on or behalf of, Tenant, Landlord shall thereafter have the right to have the relevant portion of Landlord's Contribution paid directly to such lienor upon receipt of requisite documentation from such lienor evidencing payment to be due and owing, only upon Landlord notifying Tenant in writing of its intent to pay such portion of Landlord's Contribution directly to such contractors and Tenant failing within five (5) business days of receipt of such notice to (x) bond over or discharge such lien, as a matter of record or
(y) pay such lienor (and provide evidence of such payment to Landlord) the amounts claimed owing to such lienor; (iii) Landlord shall have no obligation to pay any portion of Landlord's Contribution with respect to any Requisition submitted after July 15, 2021 (the "**Outside Requisition Date**").

12. Miscellaneous

(a) **Tenant's Authorized Representative**. Tenant designates David W. Miller (email: dmiller@dicerna.com, telephone 617-612-6220; "**Tenant's Representative**") as the only person authorized to act for Tenant pursuant to this Work Letter. Landlord shall not be obligated to respond to or act upon any request, approval, inquiry or other communication ("**Communication**") from or on behalf of Tenant in connection with this Work Letter unless such Communication is in writing from Tenant's Representative. Tenant may change either Tenant's Representative at any time upon not less than five (5) business days advance written notice to Landlord.

(b) **Landlord's Authorized Representative**. Landlord designates Michael DiMinico (email: mdiminico@ks-prop.com, telephone 617-910-5503; "**Landlord's Representative**") as the only person authorized to act for Landlord pursuant to this Work Letter. Tenant shall not be obligated to respond to or act upon any request, approval, inquiry or other Communication from or on behalf of Landlord in connection with this Work Letter unless such Communication is in writing from Landlord's Representative. Landlord may change either Landlord's Representative at any time upon not less than five (5) business days advance written notice to Tenant.

(c) Tenant shall have the right, during the performance of Landlord's Work, to have Tenant's Representative or other project manager representative participate in weekly

construction meetings with Landlord and the Contractor as to the status of the performance of the Tenant Improvement Work and the Landlord's Kitchen Work.

(d) Tenant shall have access to the Premises prior to the Term Commencement Date in accordance with the provisions of Section 1.4 of the Lease.

13. Disputes.

Any disputes relating to provisions or obligations in this Lease in connection with Landlord's Work or Tenant's Work or this Exhibit 4 shall be submitted to arbitration in accordance with the provisions of applicable state law, as from time to time amended. Arbitration proceedings, including the selection of an arbitrator, shall be conducted pursuant to the rules, regulations and procedures from time to time in effect as promulgated by the American Arbitration Association. Notwithstanding the foregoing, the parties hereby agree that the arbitrator for any disputes relating to Landlord's Work or Tenant's Work shall be a construction consultant, experienced in the construction of offices/research/laboratory buildings/campuses in the Route 128/Route 2/Alewife corridor real estate market, as mutually agreed upon by the parties, or, if not then designated by the parties, within ten (10) days after either party makes a request for arbitration hereunder, or (if the parties do not mutually agree upon such arbitrator) as designated by the Boston office of the American Arbitration Association upon request by either party. Prior written notice of application by either party for arbitration shall be given to the other at least ten (10) days before submission of the application to the said Association's office in Boston, Massachusetts. The arbitrator shall hear the parties and their evidence. The decision of the arbitrator shall be binding and conclusive, and judgment upon the award or decision of the arbitrator may be entered in the appropriate court of law; and the parties consent to the jurisdiction of such court and further agree that any process or notice of motion or other application to the Court or a Judge thereof may be served outside the Commonwealth of Massachusetts by registered mail or by personal service, provided a reasonable time for appearance is allowed. The costs and expenses of each arbitration hereunder and their apportionment between the parties shall be determined by the arbitrator in his award or decision. Except where a specified period is referenced in this Lease, no arbitrable dispute shall be deemed to have arisen under this Lease prior to the expiration of the period of twenty (20) days after the date of the giving of written notice by the party asserting the existence of the dispute together with a description thereof sufficient for an understanding thereof. In connection with the foregoing, it is expressly understood and agreed that the parties shall continue to perform their respective obligations under the Lease during the pendency of any such arbitration proceeding hereunder (with any adjustments or reallocations to be made on account of such continued performance as determined by the arbitrator in his or her award).

EXHIBIT 4-1 BASE BUILDING PLANS

B.W. KENNEDY
BUILDERS & CONSTRUCTION MANAGERS
B.W. Kennedy & Co

Printed on Mon Dec 16, 2019 at 04:10 pm EST

Job #: 1571 75 HAYDEN BASE BUILDING
75 HAYDEN AVE
LEXINGTON, Massachusetts 02421

Current Drawings

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
General					
G00-00	COVER SHEET	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
G00-01	INDEX OF DRAWINGS	5	04/05/2019	04/05/2019	ASI-07 (04/05/19)
G01-01	CODE COMPLIANCE DIAGRAMS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
Civil					
C100	PD-2 DISTRICT SITE CONTEXT PLAN	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C200	EXISTING CONDITIONS PLAN	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C300	DEMOLITION AND EROSION CONTROL PLAN	1	12/21/2018	12/21/2018	ASI-03 (12/21/18)
C400	SITE LAYOUT AND MATERIALS PLAN	7	10/29/2019	10/29/2019	ASI - 35 (10/29/19)
C401	SITE LAYOUT AND MATERIALS PLAN	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C500	SITE GRADING AND DRAINAGE PLAN	7	10/29/2019	10/29/2019	ASI - 35 (10/29/19)
C501	SITE GRADING AND DRAINAGE PLAN	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C600	SITE UTILITY PLAN	5	10/16/2019	10/16/2019	ASI - 32 (10/16/19)
C601	SITE UTILITY PLAN	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C700	SITE DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C701	SITE DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C702	SITE DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C703	SITE DETAILS AND SOIL TEST PIT LOGS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
C704	SOIL BORING LOGS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
Landscape					
L 1.01	MATERIALS WEST LANDSCAPE	4	06/28/2019	06/28/2019	ASI - 19 (06/28/19)
L 1.02	MATERIALS EAST LANDSCAPE	2	12/21/2018	12/21/2018	ASI-03 (12/21/18)
L2.01	LAYOUT WEST LANDSCAPE	3	06/28/2019	06/28/2019	ASI - 19 (06/28/19)
L3.01	PLANTING WEST	2	01/31/2019	01/31/2019	ASI-05 (01/31/19)
L3.02	PLANTING EAST	4	05/07/2019	05/10/2019	ASI - 11 (05/07/19)
L3.03	PLANT SCHEDULE	2	03/22/2019	03/22/2019	ASI-06 (03/22/19)
L3.04	IRRIGATION WEST	1	10/03/2018	10/19/2018	ASI #1
L4.01	LIGHTING WEST LANDSCAPE	2	12/21/2018	12/21/2018	ASI-03 (12/21/18)
L4.02	LIGHTING EAST LANDSCAPE	2	12/21/2018	12/21/2018	ASI-03 (12/21/18)
L5.01	DETAILS PAVING	2	06/28/2019	06/28/2019	ASI - 19 (06/28/19)
L5.02	DETAILS MISC LANDSCAPE	2	12/21/2018	01/30/2019	ASI-03 (12/21/18)
L5.03	DETAILS MISC 2 LANDSCAPE -	0	12/21/2018	01/30/2019	ASI-03 (12/21/18)
L6.01	PLANTING DETAILS 1	1	10/03/2018	10/19/2018	ASI #1
L6.02	PLANTING DETAILS 2	1	10/03/2018	10/19/2018	ASI #1
Structural					
S00-01	GENERAL NOTES I	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
S00-02	GENERAL NOTES II	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
S10-01	FOUNDATION PLAN	3	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S10-02	SECOND FLOOR FRAMING PLAN	4	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S10-03	THIRD FLOOR FRAMING PLAN	4	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S10-04	FOURTH FLOOR FRAMING PLAN	4	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S10-05	ROOF/PENTHOUSE FRAMING PLAN	4	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S10-06	PENTHOUSE ROOF FRAMING PLAN	3	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S20-01	BUILDING COLUMN SCHEDULE I	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
S20-02	BUILDING COLUMN SCHEDULE II	2	03/22/2019	03/22/2019	ASI-06 (03/22/19)
S20-03	BRACED FRAME ELEVATIONS I	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
S20-04	BRACED FRAME ELEVATIONS II	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
S20-05	BRACED FRAME ELEVATIONS III	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
S30-01	CONCRETE DETAILS I	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
S30-02	CONCRETE DETAILS II	1	03/22/2019	03/22/2019	ASI-06 (03/22/19)
S30-03	CONCRETE DETAILS III	2	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S30-04	CONCRETE DETAILS IV	3	03/22/2019	03/22/2019	ASI-06 (03/22/19)
S30-05	CONCRETE DETAILS V	3	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S40-01	STEEL DETAILS I	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
S40-02	STEEL DETAILS II	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
S40-03	STEEL DETAILS III	2	01/31/2019	01/31/2019	ASI-05 (01/31/19)
S40-04	STEEL DETAILS IV	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
S40-05	STEEL DETAILS V	1	03/22/2019	03/22/2019	ASI-06 (03/22/19)
S50-01	SECTIONS & DETAILS I	3	04/05/2019	04/05/2019	ASI-07 (04/05/19)
S50-02	SECTIONS & DETAILS II	3	04/17/2019	04/19/2019	ASI-08 (04/17/19)
Architectural					
A00-00	ARCHITECTURAL GENERAL NOTES, SYMBOLS AND ABBREVIATIONS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A00-01	ARCHITECTURAL SITE PLAN	2	01/31/2019	01/31/2019	ASI-05 (01/31/19)
A00-03	ARCHITECTURAL GRID	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A10-00	AXONOMETRIC VIEWS	2	01/31/2019	01/31/2019	ASI-05 (01/31/19)
A10-01	LEVEL 1 PLAN	7	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A10-02	LEVEL 2 & LOW ROOF PLAN	4	10/30/2019	11/05/2019	ASI - 34 (10/30/19)
A10-03	LEVEL 3 PLAN	5	10/30/2019	11/05/2019	ASI - 34 (10/30/19)
A10-04	LEVEL 4 PLAN	5	10/30/2019	11/05/2019	ASI - 34 (10/30/19)
A10-05	PENTHOUSE & ROOF PLAN	5	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
A10-06	HIGH ROOF PLAN	3	04/05/2019	04/05/2019	ASI-07 (04/05/19)
A10-12	LEVEL 2 E.O.S. PLAN	3	10/30/2019	11/05/2019	ASI - 34 (10/30/19)
A10-13	LEVEL 3 E.O.S. PLAN	3	10/30/2019	11/05/2019	ASI - 34 (10/30/19)
A10-14	LEVEL 4 E.O.S. PLAN	3	10/30/2019	11/05/2019	ASI - 34 (10/30/19)
A10-15	PENTHOUSE & ROOF E.O.S. PLAN	2	03/22/2019	03/22/2019	ASI-06 (03/22/19)

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A11-01	LEVEL 1 EAST WING	8	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A11-02	CORE PLANS	6	07/09/2019	07/09/2019	ASI - 21 (07/09/19)
A11-03	PENTHOUSE PLAN	6	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
A12-01	LEVEL 1 REFLECTED CEILIING PLAN	4	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
A12-11	LEVEL 1 ENLARGED RCPS	4	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
A13-01	LEVEL 1 FINISH & FLOOR PATTERN PLAN	2	07/09/2019	07/09/2019	ASI - 21 (07/09/19)
A13-51	ENLARGED FLOOR PATTERN PLANS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A20-01	BUILDING ELEVATIONS - NORTH & SOUTH	3	10/30/2019	11/05/2019	ASI - 34 (10/30/19)
A20-02	BUILDING ELEVATIONS - EAST & WEST	2	01/31/2019	01/31/2019	ASI-05 (01/31/19)
A30-01	EXTERIOR ASSEMBLIES	1	04/05/2019	04/05/2019	ASI-07 (04/05/19)
A30-02	TYPICAL AVB & FLASHING DETAILS	4	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A30-03	EXTERIOR MOCKUP	2	12/21/2018	12/21/2018	ASI-02 (12/21/18)
A31-01	WALL ELEVATIONS & SECTIONS	2	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A31-02	WALL ELEVATIONS & SECTIONS	2	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A31-03	WALL ELEVATIONS & SECTIONS	1	12/21/2018	12/21/2018	ASI-03 (12/21/18)
A31-04	WALL ELEVATIONS & SECTIONS	1	12/21/2018	12/21/2018	ASI-03 (12/21/18)
A31-05	WALL ELEVATIONS & SECTIONS	2	03/22/2019	03/22/2019	ASI-06 (03/22/19)
A31-06	WALL ELEVATIONS & SECTIONS	2	04/05/2019	04/05/2019	ASI-07 (04/05/19)
A31-07	CANOPY ENLARGED PLANS, SECTIONS & DETAILS	1	03/22/2019	03/22/2019	ASI-06 (03/22/19)
A32-01	EXTERIOR SECTION DETAILS	3	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A32-02	EXTERIOR SECTION DETAILS	3	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A32-03	EXTERIOR SECTION DETAILS	2	01/31/2019	01/31/2019	ASI-05 (01/31/19)
A32-04	EXTERIOR SECTION DETAILS	2	03/22/2019	03/22/2019	ASI-06 (03/22/19)
A32-05	EXTERIOR SECTION DETAILS	4	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A32-11	ROOF DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A33-01	EXTERIOR PLAN DETAILS	1	12/21/2018	12/21/2018	ASI-02 (12/21/18)
A33-02	EXTERIOR PLAN DETAILS	1	10/01/2019	10/03/2019	ASI - 28 (10/01/19)
A33-03	EXTERIOR PLAN DETAILS	2	04/05/2019	04/05/2019	ASI-07 (04/05/19)
A34-01	CURTAIN WALL W1 SCHEDULE & DETAILS	1	07/09/2019	07/09/2019	ASI - 21 (07/09/19)
A34-02A	CURTAIN WALL W2 SCHEDULE & DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A34-02B	CURTAIN WALL W2 SCHEDULE & DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A34-03	CURTAIN WALL W3 SCHEDULE & DETAILS	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
A40-01	TYPICAL MOUNTING HEIGHTS	4	07/09/2019	08/23/2019	ASI - 21 (07/09/19)
A41-01	STAIR 1 PLANS AND SECTIONS	1	12/21/2018	12/21/2018	ASI-03 (12/21/18)
A41-02	STAIR 2 PLANS AND SECTIONS	1	12/21/2018	12/21/2018	ASI-03 (12/21/18)
A41-03	STAIR 3 PLANS AND SECTIONS	1	12/21/2018	12/21/2018	ASI-03 (12/21/18)
A41-04	MISC. STAIRS & RAMPS	1	12/21/2018	12/21/2018	ASI-03 (12/21/18)
A41-51	STAIR DETAILS	1	07/09/2019	07/09/2019	ASI - 21 (07/09/19)
A42-01	PASSENGER ELEVATOR PLANS & SECTIONS	4	06/20/2019	06/28/2019	ASI - 18 (06/20/19)

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A42-02	SERVICE ELEVATOR PLANS & SECTIONS	2	03/22/2019	03/22/2019	ASI-06 (03/22/19)
A42-11	ELEVATOR DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A42-21	NORTH EXHAUST SHAFT PLANS & SECTIONS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A42-22	SOUTH EXHAUST SHAFT PLANS & SECTIONS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A42-23	CORE SHAFT PLANS & SECTIONS	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
A43-01	RESTROOM PLANS & RCPS	4	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
A43-02	RESTROOM & SHOWER ELEVATIONS	2	06/20/2019	06/28/2019	ASI - 18 (06/20/19)
A44-01	LOBBY & LIBRARY PLAN & RCP	4	10/15/2019	10/22/2019	ASI - 30 (10/15/19)
A44-02	LOBBY & LIBRARY ELEVATIONS	3	06/19/2019	06/24/2019	ASI-17 (06/19/19)
A44-03	KITCHEN AND SERVERY PLAN & RCP	4	07/26/2019	07/26/2019	ASI-10 (05/07/19)
A45-01	CORRIDOR ELEVATIONS	4	06/19/2019	06/24/2019	ASI-17 (06/19/19)
A50-01	MILLWORK SECTIONS & DETAILS	1	06/20/2019	06/28/2019	ASI - 18 (06/20/19)
A50-02	LIBRARY MILLWORK SECTIONS & DETAILS	1	07/09/2019	07/09/2019	ASI - 21 (07/09/19)
A50-03	RECEPTION DESK PLANS & ELEVATIONS	1	03/22/2019	03/22/2019	ASI-06 (03/22/19)
A50-04	RECEPTION DESK SECTIONS & DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A50-10	SERVERY MILLWORK ELEVATIONS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A50-11	SERVERY MILLWORK DETAILS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A51-01	CEILING DETAILS	2	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
A51-02	CEILING DETAILS - SERVERY & CAFE	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A52-01	INTERIOR DETAILS	2	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
A61-01	INTERIOR PARTITION TYPES	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A61-02	INTERIOR PARTITION DETAILS	1	03/22/2019	03/22/2019	ASI-06 (03/22/19)
A61-03	FIRE RESISTANCE DETAILS AND DIAGRAMS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A61-04	FIRE RESISTANCE DETAILS AND DIAGRAMS	0	09/20/2018	09/20/2018	Construction Documents (09/20/18)
A62-01	DOOR SCHEDULE & DETAILS	7	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
A63-01	INTERIOR GLASS SCHEDULE & DETAILS	2	03/22/2019	03/22/2019	ASI-06 (03/22/19)
A64-01	ROOM FINISH LEGEND & SCHEDULE	5	07/09/2019	07/09/2019	ASI - 21 (07/09/19)
HVAC					
H0.0	HVAC 3D MODEL	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H0.1	HVAC 3D MODELS	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H1.0	LEVEL ONE OVERALL HVAC PLAN	6	11/22/2019	11/22/2019	ASI - 37 (11/22/19)
H1.1	LEVEL ONE ENLARGED HVAC PLAN	5	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H1.2	LEVEL ONE ENLARGED HVAC PLAN	2	01/31/2019		ASI-05 (01/31/19)
H1.2A	LEVEL ONE ENLARGED HVAC PLAN	4	11/22/2019	11/22/2019	ASI - 37 (11/22/19)
H1.2 A	LEVEL ONE ENLARGED HVAC PLAN	1	03/22/2019		ASI-06 (03/22/19)
H1.2B	UNDERGROUND PIPING PLAN CAFE AREA	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H1.3	LEVEL ONE ENLARGED HVAC PLAN	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H1.4	LEVEL ONE OVERALL CEILING PLAN	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H2.0	LEVEL TWO OVERALL HVAC PLAN	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)

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H2.1	LEVEL TWO ENLARGED HVAC PLAN	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H3.0	LEVEL THREE OVERALL HVAC PLAN	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H3.1	LEVEL THREE ENLARGED HVAC PLAN	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H4.0	LEVEL FOUR OVERALL HVAC PLAN	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H4.1	LEVEL FOUR ENLARGED HVAC PLAN	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H5.0	PENTHOUSE OVERALL HVAC PLAN	3	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H5.1	PENTHOUSE OVERALL DUCTWORK PLAN	3	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H5.2	PENTHOUSE OVERALL PIPING PLAN	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H5.3	PENTHOUSE ENLARGED CHILLER ROOM PLAN	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H5.4	PENTHOUSE ENLARGED BOILER ROOM PLAN	3	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H5.5	PENTHOUSE ENLARGED AHU AREA PLAN NORTH	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H5.6	PENTHOUSE ENLARGED AHU AREA PLAN SOUTH	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H5.7	PENTHOUSE HOUSEKEEPING PAD PLAN	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H6.0	ROOF OVERALL HVAC PLAN	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.0	HVAC SECTIONS AHU-1A & IB	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.1	HVAC SECTIONS AHUS	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.2	HVAC SECTIONS AHUS SHAFT	3	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.3	HVAC SECTIONS EF & HRU-1&2	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.4	HVAC SECTIONS EF & HRU-3&4	3	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.5	HVAC SECTIONS BOILER RM. AREA	3	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.6	HVAC SECTIONS MACHINE RM. AREA	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.7	HVAC SECTIONS COOLING TOWER	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.8	HVAC SECTIONS ELEVATOR SHAFT	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.9	HVAC SECTIONS LEVEL ONE AREAS	5	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.10	HVAC SECTIONS LEVEL ONE AREAS	5	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.11	HVAC SECTIONS LEVEL ONE AREAS	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.12	HVAC SECTIONS LEVEL ONE AREAS	3	11/22/2019	11/22/2019	ASI - 37 (11/22/19)
H7.13	HVAC SECTIONS	1	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H7.14	HVAC SECTIONS (MUA-1 & KEF-2 & 3 SHAFTS)	1	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H8.0	HVAC DETAILS LEGENDS, & NOTES	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H8.1	HOT WATER LOOP PIPING SCHEMATIC	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H8.2	CHILLED WATER & CONDENSER WATER LOOPS PIPING SCHEMATIC	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H8.3	HEAT RECOVERY LOOP PIPING SCHEMATIC	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H9.0	HVAC SCHEDULES	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
H9.1	HVAC SCHEDULES	4	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
HC1	LEVEL ONE CLEAR FLOOR OPENING PLAN	2	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
HC2	LEVEL TWO CLEAR FLOOR OPENING PLAN	1	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
HC3	LEVEL THREE CLEAR FLOOR OPENING PLAN	1	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
HC4	LEVEL FOUR CLEAR FLOOR OPENING PLAN	1	10/30/2019	11/30/2019	ASI - 36 (11/08/19)

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HC5	PENTHOUSE CLEAR ROOF OPENING PLAN	1	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
HC6	PENTHOUSE EQUIPMENT DUNNAGE DETAILING	1	10/30/2019	11/30/2019	ASI - 36 (11/08/19)
Plumbing					
P00-00	PLUMBING LEGEND NOTES & SCHEDULE	3	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P01-00	PLUMBING UNDERGROUND PLAN - OVERALL	4	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P01-01	PLUMBING UNDERGROUND PLAN - SECTION A	3	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P01-02	PLUMBING UNDERGROUND PLAN - SECTION B	5	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P02-00	PLUMBING LEVEL 01 PLAN - OVERALL	4	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P02-01	PLUMBING LEVEL 01 PLAN - SECTION A	4	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P02-02	PLUMBING LEVEL 01 PLAN - SECTION B	4	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P03-00	PLUMBING LEVEL 02 PLAN - OVERALL	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P03-01	PLUMBING LEVEL 02 PLAN - SECTION A	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P03-02	PLUMBING LEVEL 02 PLAN - SECTION B	1	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P04-00	PLUMBING LEVEL 03 PLAN - OVERALL	1	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P04-01	PLUMBING LEVEL 03 PLAN - SECTION A	1	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P04-02	PLUMBING LEVEL 03 PLAN - SECTION B	1	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P05-00	PLUMBING LEVEL 04 PLAN - OVERALL	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P05-01	PLUMBING LEVEL 04 PLAN - SECTION A	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P05-02	PLUMBING LEVEL 04 PLAN - SECTION B	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P06-00	PLUMBING PENTHOUSE & ROOF PLAN - OVERALL	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P06-01	PLUMBING PENTHOUSE & ROOF PLAN - SECTION A	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P06-02	PLUMBING PENTHOUSE & ROOF PLAN - SECTION B	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P10-00	PLUMBING PART PLANS	1	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P10-01	PLUMBING PART PLANS	5	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P10-02	PLUMBING PART PLANS	1	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P10-03	PLUMBING PART PLANS	1	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P11-00	PLUMBING DETAILS	2	11/08/2019	11/12/2019	ASI - 36 (11/08/19)
P30-02	PLUMBING FLOOR PENETRATIONS-2ND FLOOR SLAB	0	01/31/2019	01/31/2019	ASI-05 (01/31/19)
P30-03	PLUMBING FLOOR PENETRATIONS-3RD FLOOR SLAB	0	01/31/2019	01/31/2019	ASI-05 (01/31/19)
P30-04	PLUMBING FLOOR PENETRATIONS-4TH FLOOR SLAB	0	01/31/2019	01/31/2019	ASI-05 (01/31/19)
P30-05	PLUMBING FLOOR PENETRATIONS - PENTHOUSE FLOOR	0	01/31/2019	01/31/2019	ASI-05 (01/31/19)
Fire Protection					
FP0.00	FIRE SPRINKLER DETAILS	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP1.00	FIRE SPRINKLER PLAN LEVEL 01	3	03/22/2019	03/22/2019	ASI-06 (03/22/19)
FP1.01	FIRE SPRINKLER PLAN LEVEL 01	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP1.02	FIRE SPRINKLER PLAN LEVEL 01	3	03/22/2019	03/22/2019	ASI-06 (03/22/19)
FP2.00	FIRE SPRINKLER PLAN LEVEL 02	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP2.01	FIRE SPRINKLER PLAN LEVEL 02	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP2.02	FIRE SPRINKLER PLAN LEVEL 02	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP3.00	FIRE SPRINKLER PLAN LEVEL 03	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
FP3.01	FIRE SPRINKLER PLAN LEVEL 03	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP3.02	FIRE SPRINKLER PLAN LEVEL 03	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP4.00	FIRE SPRINKLER PLAN LEVEL 04	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP4.01	FIRE SPRINKLER PLAN LEVEL 04	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP4.02	FIRE SPRINKLER PLAN LEVEL 04	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
FP5.00	FIRE SPRINKLER PLAN PENTHOUSE LEVEL	2	01/31/2019	02/01/2019	ASI-05 (01/31/19)
Electrical					
E00.00	ELECTRICAL LEGEND	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E00.01	ELECTRICAL SITE DEMOLITION PLAN	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E00.02	ELECTRICAL AXONOMETRIC VIEW	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E01.00	ELECTRICAL SITE UTILITY PLAN	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E01.01	ELECTRICAL SITE UTILITY PLAN ENLARGED	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E01.02	ELECTRICAL SITE AND DUCTBANK DETAILS	2	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E01.03	ELECTRICAL SITE LIGHTING PLAN	4	08/09/2019	08/12/2019	ASI - 25 (08/09/19)
E01.04	ELECTRICAL SITE LIGHTING DETAILS	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E01.05	ELECTRICAL BUILDING UNDERGROUND PLAN	2	09/13/2019	09/13/2019	ASI - 27 (09/13/19)
E01.06	ELECTRICAL LOBBY UNDERGROUND ENLARGED PLAN	0	09/13/2019	09/13/2019	ASI - 27 (09/13/19)
E01.07	ELECTRICAL LOBBY STUB-UP PLAN	0	09/13/2019	09/13/2019	ASI - 27 (09/13/19)
E01.08	ELECTRICAL MAIN ELECTRIC ROOM UNDERGROUND ENLARGED PLAN	0	09/13/2019	09/13/2019	ASI - 27 (09/13/19)
E01.09	ELECTRICAL CAFE UNDERGROUND ENLARGED PLAN	0	09/13/2019	09/13/2019	ASI - 27 (09/13/19)
E01.10	ELECTRICAL CAFE STUB-UP PLAN	0	09/13/2019	09/13/2019	ASI - 27 (09/13/19)
E02.00	ELECTRICAL RISER PLAN - SERVICE ENTRANCE	2	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E02.01	ELECTRICAL RISER PLAN - MAIN DISTRIBUTION	2	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E02.02	ELECTRICAL RISER PLAN - BUSDUCT DISTRIBUTION	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E02.03	ELECTRICAL GROUNDING RISER DIAGRAM	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E02.04	ELECTRICAL PANELBOARD SCHEDULES	2	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E02.05	ELECTRICAL PANELBOARD SCHEDULES	5	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E02.06	ELECTRICAL MECHANICAL AND PLUMBING SCHEDULE	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E03.01	ELECTRICAL POWER PLAN - LEVEL 01	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E03.02	ELECTRICAL POWER PLAN - LEVEL 02	2	10/23/2019	10/25/2019	ASI - 31 (10/23/19)
E03.03	ELECTRICAL POWER PLAN - LEVEL 03	2	10/23/2019	10/25/2019	ASI - 31 (10/23/19)
E03.04	ELECTRICAL POWER PLAN - LEVEL 04	4	10/23/2019	10/25/2019	ASI - 31 (10/23/19)
E03.05	ELECTRICAL POWER PLAN - PENTHOUSE LEVEL	3	07/09/2019	07/23/2019	ASI - 20 (07/09/19)
E03.06	ELECTRICAL POWER PLAN - ROOF LEVEL	2	10/23/2019	10/25/2019	ASI - 31 (10/23/19)
E04.01	ELECTRICAL POWER PLAN - LEVEL 01 PARTIAL PLAN	6	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E04.02	ELECTRICAL POWER PLAN ENLARGED LEVEL 01 MAIN ELEC./ MECH. ROOM	2	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E04.03	ELECTRICAL POWER PLAN - LEVEL 01 KITCHEN	6	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E04.04	ELECTRICAL - KITCHEN ANSUL SYSTEM DETAIL	3	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E04.05	ELECTRICAL POWER PLAN - ENLARGED PENTHOUSE EAST	2	10/23/2019	10/25/2019	ASI - 31 (10/23/19)

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E04.06	ELECTRICAL DETAILS	0	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E05.00	ELECTRICAL LIGHTING SCHEDULES	3	07/09/2019	07/23/2019	ASI - 20 (07/09/19)
E05.01	ELECTRICAL LIGHTING PLAN - LEVEL 01	3	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E05.02	ELECTRICAL LIGHTING PLAN - LEVEL 02	3	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E05.03	ELECTRICAL LIGHTING PLAN - LEVEL 03	3	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E05.04	ELECTRICAL LIGHTING PLAN - LEVEL 04	3	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E05.05	ELECTRICAL LIGHTING PLAN - PENTHOUSE LEVEL	3	10/10/2019	10/15/2019	ASI - 29 (10/10/19)
E06.01	ELECTRICAL LIGHTING PLAN - LEVEL 01 ENLARGED PLAN	5	11/22/2019	11/22/2019	ASI - 37 (11/22/19)
E06.02	ELECTRICAL LIGHTING PLAN - STAIRWAY ELEVATION	0	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
E07.01	FIRE ALARM PLAN - LEVEL 01	5	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E07.02	FIRE ALARM PLAN - LEVEL 02	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E07.03	FIRE ALARM PLAN - LEVEL 03	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E07.04	FIRE ALARM PLAN - LEVEL 04	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E07.05	FIRE ALARM PLAN - PENTHOUSE LEVEL	3	07/09/2019	07/23/2019	ASI - 20 (07/09/19)
E07.06	FIRE ALARM RISER AND NOTES PLAN	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E07.07	FIRE ALARM DETAILS AND BDA RISER PLAN	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E08.00	ELECTRICAL TELCOM RISER PLAN	4	10/23/2019	10/25/2019	ASI - 31 (10/23/19)
E08.01	ELECTRICAL LOW VOLTAGE RACK DETAILS	1	07/09/2019	07/23/2019	ASI - 20 (07/09/19)
E08.02	ELECTRICAL TELCOM PLAN - LEVEL 01	1	07/09/2019	07/23/2019	ASI - 20 (07/09/19)
E08.03	ELECTRICAL TELCOM PLAN - PENTHOUSE LEVEL	1	07/09/2019	07/23/2019	ASI - 20 (07/09/19)
E09.01	ELECTRICAL TELCOM ENLARGED ROOM PLANS	2	10/23/2019	10/25/2019	ASI - 31 (10/23/19)
E10.01	ELECTRICAL COORDINATION PLAN - LEVEL 01	2	03/22/2019	03/22/2019	ASI-06 (03/22/19)
E10.02	ELECTRICAL COORDINATION PLAN - TYPICAL FOR LEVELS 02,03, & 04	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E10.03	ELECTRICAL COORDINATION PLAN - PENTHOUSE LEVEL	2	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E10.04	ELECTRICAL COORDINATION PLAN - PENTHOUSE ISOMETRIC VIEWS	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E10.05	ELECTRICAL COORDINATION PLAN - BUSDUCT ISOMETRIC VIEW	1	01/31/2019	01/31/2019	ASI-05 (01/31/19)
E11.01	ELECTRICAL EXTERIOR ELEVATIONS	1	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
E11.02	ELECTRICAL PENTHOUSE EXTERIOR ELEVATIONS	2	10/10/2019	10/15/2019	ASI - 29 (10/10/19)
E12.01	ELECTRICAL COORDINATION PLAN CONDUIT PENETRATIONS	0	01/31/2019	01/31/2019	ASI-05 (01/31/19)
EC100	ELECTRICAL BUSDUCT PLAN	0	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
EC200	ELECTRICAL HANGER COORDINATION PLAN - PENTHOUSE LEVEL	0	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
EC201	ELECTRICAL HANGER COORDINATION PLAN - ENLARGED PH EAST	0	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
EC202	ELECTRICAL HANGER COORDINATION PLAN - ENLARGED PH WEST	0	10/29/2019	10/29/2019	ASI - 36 (11/08/19)
FOODSERVICE					
FS.1	Food Service Equipment Layout & Schedule	1	11/04/2019	11/04/2019	ASI - 33 (11/04/19)
FS.2	Food Service Equipment Electrical Rough-In Plan	1	11/04/2019	11/04/2019	ASI - 33 (11/04/19)
FS.3	Food Service Equipment Plumbing Rough-In Plan	1	11/04/2019	11/04/2019	ASI - 33 (11/04/19)
FS.4	Food Service Equipment Special Conditions Plan	1	11/04/2019	11/04/2019	ASI - 33 (11/04/19)
K0.1	FOOD SERVICE COORDINATION NOTES	1	08/30/2019	09/10/2019	ASI - 24 (08/30/19)

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K1.1	FOOD SERVICE UTILITY SCHEDULE	3	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
K1.2	FOOD SERVICE UTILITY SCHEDULE	3	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
K2.1	FOOD SERVICE EQUIPMENT LAYOUT PLAN	4	08/30/2019	09/10/2019	ASI - 24 (08/30/19)
AV & Tel/Data					
AV.A10-01	LEVEL 1 PLAN	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.A10-02	LEVEL 2 & LOW ROOF PLAN	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.A10-03	LEVEL 3 PLAN	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.A10-04	LEVEL 4 PLAN	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.A10-05	PENTHOUSE & ROOF PLAN	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.A10-06	HIGH ROOF PLAN	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.A50-03	RECEPTION DESK PLANS & ELEVATIONS	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.A50-10	SERVERY MILLWORK DETAILS	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.E08.00	ELECTRICAL TELCOM RISER PLAN	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.E08.01	ELECTRICAL LOW VOLTAGE RACK DETAILS	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
AV.E08.02	ELECTRICAL TELCOM PLAN - LEVEL 01	0	05/22/2019	06/04/2019	ASI-12 (05/22/19)
Signage					
GS.2	PROJECT STANDARDS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.3	BRANDING AND SIGNAGE TABULATION	1	07/15/2019	07/15/2019	RFI 131 (07/15/19)
GS.4	L1 SIGN PLAN	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.5	L2 SIGN PLAN	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.6	L3 SIGN PLAN	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.7	L4 SIGN PLAN	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.8	PH SIGN PLAN	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.9	WG1-2 RECEPTION	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.10	WG2 NICHE DETAIL	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.11	WG3 ELEVATOR LOBBY	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.12	WG3 ELEVATOR/LOBBY	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.13	AD1 LOBBY LIBRARY WALL	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.14	AD1 LOBBY LIBRARY WALL DETAIL	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.15	WG4 CAFE ID	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.16	WG4 CAFE ID / DETAILS	1	07/15/2019	07/15/2019	RFI 131 (07/15/19)
GS.17	WG4 CAFE ID / DETAILS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.18	WG4 CAFE LOGO DEVELOPMENT	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.19	WG4 CAFE LOGO DEVELOPMENT	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.20	WG5 CAFE GLASS WALL STUDY	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.21	AD2/WG6 ELEVATIONS	1	07/15/2019	07/15/2019	RFI 131 (07/15/19)
GS.22	CG CAFE GLASS EAST	1	07/15/2019	07/15/2019	RFI 131 (07/15/19)
GS.23	CG CAFE GLASS SOUTH	1	07/15/2019	07/15/2019	RFI 131 (07/15/19)
GS.24	NS NO SMOKING	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.25	DG1 WEST ENTRY GRAPHICS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)

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GS.26	LD1/2 LOADING DOCK ID	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.27	LD2/NSP SIGN PLAQUE	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.28	RM ROOM PLAQUE	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.29	RR RESTROOM PLAQUE	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.30	RF RESTROOM FLAG MOUNT	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.31	ST STAIR ID	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.32	SL STAIR LEVEL	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.33	UT UTILITY PLAQUE	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.34	EG ELEVATOR EGRESS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.35	EP EVACUATION PLAN	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.36	PERFORMANCE SPECIFICATIONS	1	07/15/2019	07/15/2019	RFI 131 (07/15/19)
GS.37	PERFORMANCE SPECIFICATIONS	1	07/15/2019	07/15/2019	RFI 131 (07/15/19)
GS.38	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.39	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.40	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
GS.41	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.2	LEXINGTON SIGN BYLAWS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.3	BRAND STANDARDS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.4	SIGN TABULATION	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.5	CAMPUS SIGNAGE LINEUP	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.6	75 MONUMENT & ADDRESS / LOCATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.7	CAMPUS DIRECTIONALS / LOCATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.8	PD/LOCATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.9	PARKING STRUCTURE ID / LOCATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.10	PARKING UPDATED	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.11	ID / NEW MONUMENT	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.12	Campus Wayfinding Design Intent Pricing	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.13	Campus Wayfinding Design Intent Pricing	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.14	BI / 75 BUILDING IDENTITY	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.15	PS / PARKING STRUCTURE ID	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.16	GE1 GARAGE ENTRY / RETROFIT	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.17	DR / TYPICAL MESSAGE UPDATE	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.18	DR CAMPUS DIRECTIONAL	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.19	PD PEDESTRIAN DIRECTIONAL / GRAPHIC LAYOUT	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.20	TH-P TRAILHEAD PARKING	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.21	TR2 TRAFFIC REGULATORY	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.22	PARKING REGULATORY	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.23	PARKING REGULATORY	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.24	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)

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SG.25	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.26	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.27	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.28	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
SG.29	PERFORMANCE SPECIFICATIONS	0	05/28/2019	06/10/2019	ASI - 15 Signage (05/28/19)
Elevator Shop Drawings					
PE - 1	GROUP LAYOUT	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 2	HOISTWAY	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 3	HOISTWAY	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 4	HOISTWAY	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 5	RAILSTACK	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 6	RAILSTACK	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 7	RAILSTACK	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 8	CONTROLLER	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 9	CONTROLLER	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 10	CONTROLLER	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 11	REACTION	3	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 12	REACTION	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 13	REACTION	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 14	BRACKET	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 15	BRACKET	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 16	BRACKET	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 17	DATA	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 18	CONTRACT	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 19	CONTRACT	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 20	CAB	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 21	CAB	1	03/19/2019	04/11/2019	Shop Drawings (03/19/19)
PE - 22	CAB	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 23	ENTRANCE	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 24	ENTRANCE	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 25	ENTRANCE	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 26	ENTRANCE	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 27	ENTRANCE	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 28	ENTRANCE	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 29	COP	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 30	COP	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 31	COP	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 32	HPB	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 33	HPB	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 34	HL	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
PE - 35	HL	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
PE - 36	HL	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 1	HOISTWAY	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 2	RAILSTACK	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 3	CONTROLLER	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 4	REACTION	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 5	BRACKET	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 6	DATA	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 7	CONTRACT	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 8	CONTRACT	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 9	CAB	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 10	ENTRANCE	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 11	ENTRANCE	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE -12	COP	0	03/19/2019	04/11/2019	Shop Drawings (03/19/19)
SE - 12	COP	1	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 13	SHEET 13 of 15	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 14	SHEET 14 of 15	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
SE - 15	SHEET 15 of 15	2	03/19/2019	06/07/2019	Shop Drawings (03/19/19)
LGMF Shop Drawings					
LG1	FIRST FLOOR WALL LAYOUT PLAN	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG2	SECOND FLOOR WALL LAYOUT PLAN	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG3	THIRD FLOOR WALL LAYOUT PLAN	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG4	FOURTH FLOOR WALL LAYOUT PLAN	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG5	PENTHOUSE WALL LAYOUT PLAN	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG6	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG7	WALL FRAMING DETAILS	1	03/19/2019	12/05/2019	Shop Drawings (03/19/19)
LG8	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG9	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG10	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG11	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG12	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG13	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG14	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG15	WALL FRAMING DETAILS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG16	WALL FRAMING ELEVATIONS	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
LG17	WALL FRAMING ELEVATIONS (HDS OPTIONS)	0	03/19/2019	06/10/2019	Shop Drawings (03/19/19)
Curtainwall Shop Drawings					
CW 1	LEVEL 1 FLOOR PLAN	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 2	LEVEL 2 FLOOR PLAN	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 3	LEVEL 3 FLOOR PLAN	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
CW 4	LEVEL 4 FLOOR PLAN	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 5	SOUTH AND EAST ELEVATIONS	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 6	NORTH AND WEST ELEVATIONS	1	03/19/2019	09/11/2019	Shop Drawings (03/19/19)
CW 7	WEST ELEVATIONS	1	03/19/2019	09/11/2019	Shop Drawings (03/19/19)
CW 8	CURTAINWALL SCHEDULE 1	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 9	CURTAINWALL SCHEDULE 2	1	03/19/2019	09/11/2019	Shop Drawings (03/19/19)
CW 9A	CURTAINWALL SCHEDULE 2	0	03/19/2019	09/11/2019	Shop Drawings (03/19/19)
CW 10	CURTAINWALL SCHEDULE 3	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 11	CURTAINWALL SCHEDULE 4	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 12	CURTAINWALL SCHEDULE 5	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 13	CURTAINWALL SCHEDULE 6	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 14	CURTAINWALL SCHEDULE 7	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 15	CURTAINWALL SCHEDULE 8	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 16	INTERIOR GLASS	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 17	DETAILS 1-8	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 18	DETAILS 9 - 17	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 19	DETAILS 18 - 23	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 20	DETAILS 24 - 32	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 21	DETAILS 33 - 36	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 22	DETAILS 37 - 44	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
CW 23	DETAILS 45 - 48	0	03/19/2019	06/27/2019	Shop Drawings (03/19/19)
Hope's Shop Drawings					
HS 1	COVER PAGE	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 2	GLAZING	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 3	CAFE HOPE'S SYSTEM	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 4	DETAILS	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 5	TENANT DOOR 108.1	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 6	DETAILS	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 7	LIBRARY	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 8	LIBRARY	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 9	LIBRARY	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 10	DETAILS	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 11	TENANT DOOR 107.1	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 12	DETAILS	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 13	DOOR 100A.2	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 14	MAIN VESTIBULE	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
HS 15	DETAILS	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
Canopy Shop Drawings					
CANOPY 1	Canopy Glass Schedule	0	03/19/2019	08/12/2019	Shop Drawings (03/19/19)
Rakks Shop Drawings					

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
RS 1	RAKKS SHELVING	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
RS 2	DETAILS 1 - 9	0	03/19/2019	07/29/2019	Shop Drawings (03/19/19)
Won Door Shop Drawings					
WD 1	NOTES	1	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
WD 2	FIREGUARD PLAN VIEW	1	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
WD 3	FIREGUARD ELEVATION	1	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
WD 4	FIREGUARD HEAD DETAIL	1	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
WD 5	FIREGUARD DETAIL	1	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
WD 6	FIREGUARD PERSPECTIVE	1	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
WD 7	ELECTRICAL DETAIL	1	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
Mirror Shop Drawings					
MIRRORS 1	FRAMELESS MIRRORS	0	03/19/2019	08/19/2019	Shop Drawings (03/19/19)
Tile Shop Drawings					
TILE 1	DILEX MOVEMENT JOINT LOCATION (TILE)	3	03/19/2019	07/09/2019	Shop Drawings (03/19/19)
Hunter Douglas Metal Ceiling					
HD 1	PARTIAL RCP AT LEVEL 1	0	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
HD 2	TORSION SPRING PANEL & SYSTEM DETAILS	0	03/19/2019	10/01/2019	Shop Drawings (03/19/19)
Metal Panel Shop Drawings					
MP C-1	COVER SHEET	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP D-1	DETAILS	1	03/19/2019	10/02/2019	Shop Drawings (03/19/19)
MP D-2	DETAILS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP D-3	DETAILS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP D-4	DETAILS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP D-5	DETAILS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP D-6	DETAILS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP D-7	DETAILS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP D-8	DETAILS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP D-9	DETAILS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP E-1	ELEVATIONS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP E-2	ELEVATIONS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP E-3	ELEVATIONS PENTHOUSE	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP E-4	ELEVATIONS PENTHOUSE	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP L-1	LAYOUT	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP L-2	LAYOUT	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP L-3	LAYOUT	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP L-4	LAYOUT	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP L-5	LAYOUT	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP L-6	ELEVATIONS	1	03/19/2019	09/16/2019	Shop Drawings (03/19/19)
MP L-7	LAYOUT	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP L-8	LAYOUT	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)

Drawing No.	Drawing Title	Revision	Drawing Date	Received Date	Set
MP L-9	LAYOUT	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP P-1	PLAN	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP P-2	PLANS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP P-3	AXONOMETRIC	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-1	SECTION	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-2	SECTION	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-3	SECTION	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-4	SECTION	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-5	SECTION J & H CHANNELS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-6	SECTION	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-7	SECTION	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-8	SECTION	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-9	SECTION	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-10	SECTIONS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-11	SECTIONS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)
MP S-12	SECTIONS	0	03/19/2019	09/13/2019	Shop Drawings (03/19/19)

EXHIBIT 4-2 TENANT/LANDLORD RESPONSIBILITY MATRIX

75 Hayden Avenue
Lexington, MA

KSP King Street Properties

Dicerna
Landlord / Tenant Responsibility Matrix

Scope Description	Base Building Work	Tenant Improvement Work	Tenant's Work
Exterior/Sitework			
Hardscape/Landscape: New landscaping throughout site. New, shared tenant outdoor seating area on west and east side of building. Open boardwalk from covered garage to Building.	X		
Parking Area: New parking lot paving, curbing, line striping and site lighting.	X		
Utilities: New underground storm drainage structures and piping, new gas service, new primary-metered electric service, domestic water service, fire protection water service, sanitary sewer service, new telephone/internet service to building demarcation room.	X		
Signage: New monument sign on Hayden Avenue with building address and tenant identification (sign will allow identification of multiple building tenants). New site wayfinding signage throughout site including loading dock identification.	X		
Loading: Two (2) Building common tailgate-height loading bays and one (1) Building common trash compactor bay.	X		
Structural			
Composite concrete deck on structural steel framing with live load capacity of 100 psf with the exception of certain areas along the western facade of the Building. Note that installation of all heavy equipment must be reviewed and approved by Landlord's structural engineer.	X		
Structural framing and dunnage for Base Building equipment	X		
Structural framing and dunnage for Tenant equipment (if required)		X	
Miscellaneous metals and/or concrete pads required for Tenant equipment (if required)		X	
Roofing/Penthouse			
Roofing penetrations for Base Building equipment	X		
Roofing penetrations for Tenant equipment		X	
Walkway pads for Base Building equipment as shown in Base Building Work per Exhibit 4-1.	X		
Walkway pads to Tenant equipment subject to Landlord review and approval.		X	
Interior Construction - Tenant Premises			
Control Areas: - Tenant will be allocated the following capacity for the storage and use of hazardous materials as defined by the International Building Code. Tenant's use of hazardous materials will not limit the usage of hazardous materials by any other tenant of the Building, - Third Floor Premises - **2 of the 2** available 3rd floor Control Areas; - First Floor Shared Chemical Storage Room - **50% of the capacity of one Control Area** at the first floor Chemical Storage Room		X	
Demising Wall and Exterior Wall: Drywall finish and fire safing (if required) at inside face of exterior walls and tenant face of demising wall.		X	
Tenant Build-Out: Interior construction of the Premises including partitions, flooring, ceilings, painting, finishes, interior glazing, lab casework, doors, frames and hardware, signage, etc.		X	
Core bathrooms and finishes as shown in Exhibit 4-1	X		
Furniture: Furnish and install cubicles, work stations, reception desk, and other office furniture			X

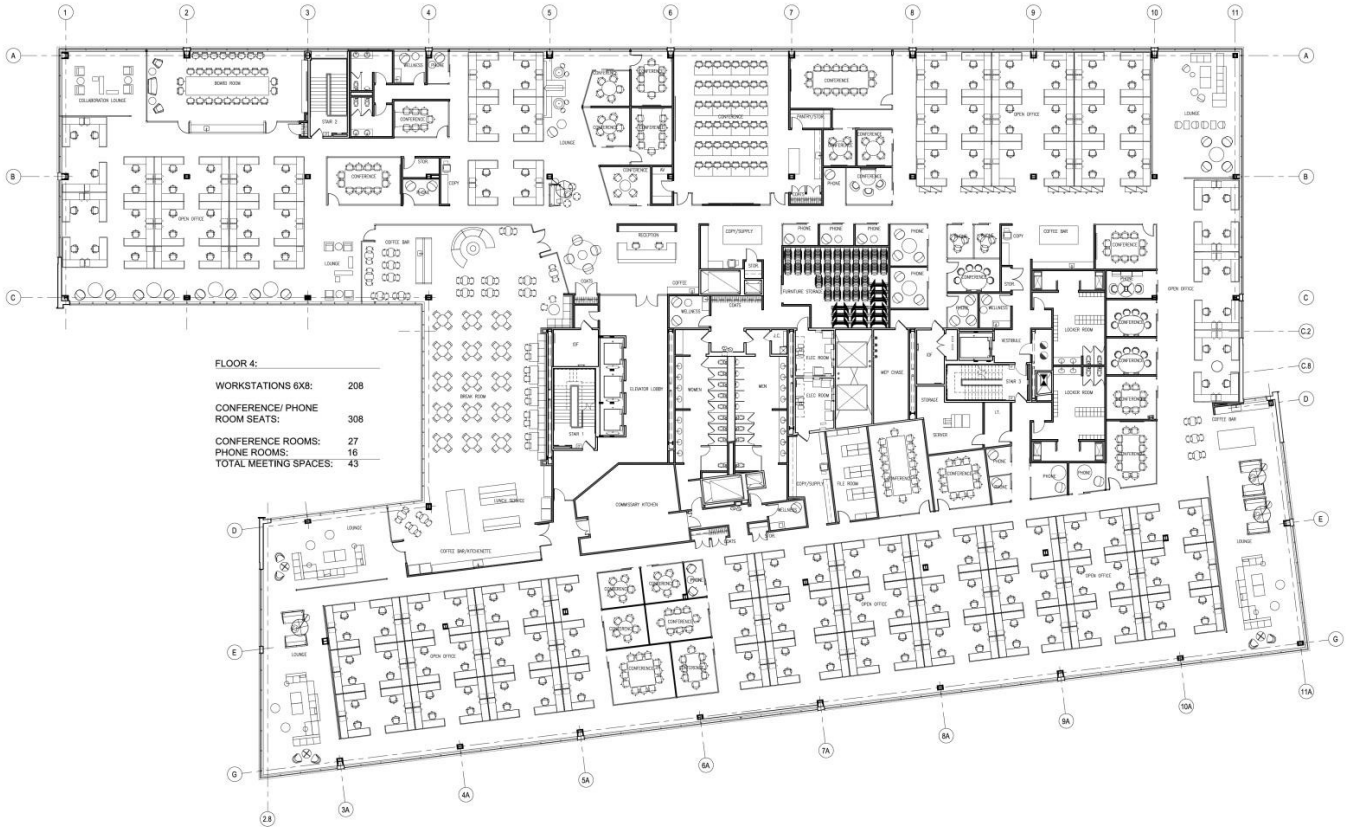
Scope Description	Base Building Work	Tenant Improvement Work	Tenant's Work
Landlord Supplied Lab Equipment: - Chemical Fume Hoods, RODI pure water systems, glass wash, autoclave, gas manifolds, dedicated compressors & vacuum pumps.		X	
Building Common Equipment: Central Compressed Air System & Central Vacuum System with connection at house riser.	X		
Tenant Supplied Lab Equipment: All lab equipment not defined as Landlord Supplied Lab Equipment, including but not limited to bench top equipment, bioreactors, centrifuges, biosafety cabinets, glassware, refrigerators, freezers, HPLCs, NMR, vivarium cages and racks, and other specialty laboratory equipment.			X
Telephone/Data/AV/Security			
Tel/data: Tel/data cabling from building demarcation room to tenant premises. Tenant IDF closets. Phone/internet service from additional cable/internet providers other than service providers brought to demarcation room by Landlord.			X
Tel/data: Pathways from building demarcation room to Tenant tel/data rooms	X		
Security/Card Access: Security systems for Tenant Premises shall be separate from the Base Building security system. Card access at exterior tenant entrance doors to the Premises and any security access within the Premises are furnished and installed by the Tenant.			X
A/V: Audio/visual systems within Tenant Premises.			X
Alarm Point: Alarm point wiring and monitoring for Tenant laboratory equipment			X
Plumbing			
Furnish and install manifolds, distribution piping, and drops to equipment as required for laboratory gases including CO2, nitrogen, vacuum, purified water. Furnish and install drains and tie-ins for Tenant equipment such as glass wash and autoclave. Furnish and install any specialty process and waste piping. Furnish and install pH neutralization tank. Furnish and install all lab sinks and drain piping (including pH branch lines to Tenant pH neutralization tank). Furnish and install emergency eyewash stations and emergency showers.		X	
Plumbing and fixtures for core bathrooms and Building common locker rooms per Exhibit 4-1.	X		
Modifications to core bathrooms or other core areas as constructed per Exhibit 4-1		X	
Building Common Vacuum and Compressed Air risers for Tenant connection.	X		
Furnish and install any sinks or water lines in Tenant kitchen or other areas within the Premises.		X	
Plumbing risers for Tenant pH neutralization system.	X		
Furnish and install Tenant pH neutralization system		X	
Branch piping for Tenant pH neutralization system.		X	
Tenant hot water tanks for the Premises to be located in the penthouse.		X	
Base Building central hot water tanks located in the penthouse per Exhibit 4-1.	X		

Scope Description	Base Building Work	Tenant Improvement Work	Tenant's Work
HVAC			
The Tenant air allowance from the Building common penthouse HVAC equipment is 53,000 CFM.	X		
Base Building Penthouse mechanical equipment - Air Handlers, boilers, chillers, exhaust fans, and penthouse duct work as shown on drawings reference in Exhibit 4-1. Supply and Exhaust duct risers as shown on drawings references in Exhibit 4-1	X		
Building Management System (BMS) for common areas and Base Building infrastructure	X		
Building Management System (BMS) for Tenant equipment and infrastructure		X	
Furnish and install all branch supply, return, and exhaust duct work from riser, Fan Coil Units & VAV terminals for space, , hot water, refrigerant and condensate piping, ductwork and piping insulation, provisions for low end humidification, specialty exhaust systems, registers, grilles, and diffusers.		X	
Tenant specific supplemental cooling systems as required by tenant program		X	
Electrical			
The maximum power from Base Building Systems allocated to Tenant to supply power to their equipment and Premises is 471,560 watts.	X		
Installation of bus duct risers as shown on drawings referenced in Exhibit 4-1	X		
Electrical power distribution equipment and wiring from busduct riser to Tenant Premises. Including Tenant Busduct Switches, Tenant Panelboards, Transformers etc.		X	
Electronic Check Metering to Monitor Tenant Power and Lighting Loads originating via common busduct riser and base building panelboards. Electronic Check Metering to match building standard Quad Logic Metering		X	
Natural Gas Optional Standby Generator to be located on the roof and associated distribution to supply backup power to Tenant Equipment. Including Tenant Automatic Transfer Switches, Tenant Panelboards, Transformers.		X	
Any UPS (Uninterrupted Power Supply) equipment, wiring and power generation/storage required.		X	
Provide power to offices, conference rooms, and general convenience outlets for non-specific areas, and Tenant furniture.		X	
Office and lab area lighting		X	
Fire alarm sub panels, remote power supplies and devices for Tenant Premises with integration into Base Building system		X	
Alteration to fire alarm system to facilitate Tenant program		X	
Furnish and install conduit for Tenant tel/data cable routing from building MDF and IDF Closet to Tenant server room.		X	
Electrical power for Tenant equipment.		X	

Scope Description	Base Building Work	Tenant Improvement Work	Tenant's Work
Fire Protection			
Sprinkler Main Service: Building service located in base building fire protection room on 1st floor. Service sized to manage to Ordinary Hazard Group II classifications of tenant suites suitable for research and development, laboratory and office uses.	X		
Standpipes: New automatic wet-pipe sprinkler and combination standpipe systems located in stairwells.	X		
Base Building Areas: New, automatic wet-pipe sprinkler coverage. New fire extinguishers.	X		
Tenant Areas: New sprinkler distribution to tenant premises. All run outs and heads within tenant premises. New fire extinguishers and cabinets within tenant premises.		X	
Base Building Scope			
Provide Base Building Scope per the plans in specifications listed in Exhibit 4-1, including but not limited to the following:	X		
- Core bathrooms, core IDF and electric rooms, supply and exhaust shafts, core MEP risers.	X		
- Common locker room and shower facilities at 1st floor	X		
- Bike storage room at 1st floor	X		
- Passenger and freight elevators	X		
- Exterior landscaping and site improvements as shown on the drawings referenced in Exhibit 4-1	X		
- Building common lobby and library	X		
- Common café at 1st floor	X		
- Building common penthouse HVAC equipment	X		

EXHIBIT 4-3 TENANT SCHEMATIC PLAN

[see attached]



FLOOR 4:

WORKSTATIONS 6X8:	208
CONFERENCE/ PHONE ROOM SEATS:	308
CONFERENCE ROOMS:	27
PHONE ROOMS:	16
TOTAL MEETING SPACES:	43

R.E. DINNEEN
ARCHITECTS &
PLANNERS, INC.

123 North Washington Street Boston, Massachusetts 02114-2343
tel 617 227 7727 fax 617 227 1870

CLIENT

Dicerna

CONSULTANT

REVISION
NO. DATE REMARKS

PROJECT NO. 19222.11

PROJECT NAME DICERNA PHARMACEUTICALS

75 HAYDEN AVENUE
LEXINGTON
MASSACHUSETTS

SHEET TITLE PRELIMINARY LAYOUT
FOURTH FLOOR

ISSUE DATE : 12/10/2019
APPROVED BY : DF
CHECKED BY : DF
DRAWN BY : DF
SCALE : 3/32"=1'-0"

PL-3

EXHIBIT 5

BASE BUILDING CAPACITIES

- HVAC – supply air capacity to the Premises: 54,500 CFM
- Power – lights, plugs, misc. equipment solely serving the Premises: 469,000 watts

EXHIBIT 6

FORM OF LETTER OF CREDIT

L/C DRAFT LANGUAGE

IRREVOCABLE STANDBY LETTER OF CREDIT NUMBER __ ISSUE DATE: __

ISSUING BANK:
SILICON VALLEY BANK 3003 TASMAN DRIVE
2ND FLOOR, MAIL SORT HF210 SANTA CLARA, CALIFORNIA 95054

BENEFICIARY:
HCP/King 75 Hayden LLC c/o King Street Properties
800 Boylston Street, Suite 1570
Boston, MA 02199 Attention: Stephen D. Lynch

APPLICANT:
DICERNA PHARMACEUTICALS, INC.
33 Hayden Avenue
Lexington, MA 02421
Attn: David W. Miller, PhD, SVP

AMOUNT: US$1,519,282.90 (ONE MILLION FIVE HUNDRED NINETEEN THOUSAND TWO HUNDRED EIGHTY TWO AND 90/100 U.S. DOLLARS)

EXPIRATION DATE: _____, 20 (ONE YEAR FROM ISSUE DATE) PLACE OF EXPIRATION: ISSUING BANK'S

COUNTERS AT ITS ABOVE ADDRESS DEAR SIR/MADAM:

WE HEREBY ESTABLISH OUR IRREVOCABLE STANDBY LETTER OF CREDIT NO. SVBSF__IN YOUR FAVOR AVAILABLE BY PAYMENT AGAINST YOUR PRESENTATION TO US OF THE FOLLOWING DOCUMENT:

1.BENEFICIARY'S SIGNED AND DATED STATEMENT STATING AS FOLLOWS:

"LANDLORD IS ENTITLED TO DRAW DOWN ON THE LETTER OF CREDIT UNDER THAT CERTAIN LEASE AGREEMENT BETWEEN DICERNA PHARMACEUTICALS, INC., AS TENANT, AND HCP/KING 75 HAYDEN LLC, AS LANDLORD, AS AMENDED, SUPPLEMENTED OR OTHERWISE MODIFIED TO DATE. THE UNDERSIGNED HEREBY CERTIFIES THAT: (I) THE UNDERSIGNED IS AN AUTHORIZED REPRESENTATIVE OF LANDLORD; (II) LANDLORD IS THE BENEFICIARY OF LETTER OF CREDIT NO. SVBSF__ ISSUED BY SILICON VALLEY BANK; AND (III) LANDLORD IS AUTHORIZED TO DRAW DOWN ON THE LETTER OF CREDIT. THE AMOUNT HEREBY DRAWN UNDER THE LETTER OF CREDIT IS US$___, WITH PAYMENT TO BE MADE TO THE FOLLOWING ACCOUNT: [INSERT WIRE INSTRUCTIONS (TO INCLUDE NAME AND ACCOUNT NUMBER OF THE BENEFICIARY)"

PARTIAL DRAWS AND MULTIPLE PRESENTATIONS ARE ALLOWED.

THIS LETTER OF CREDIT SHALL BE AUTOMATICALLY EXTENDED FOR AN ADDITIONAL PERIOD OF ONE YEAR, WITHOUT AMENDMENT, FROM THE PRESENT OR EACH FUTURE EXPIRATION DATE UNLESS AT LEAST 60 DAYS PRIOR TO THE THEN CURRENT EXPIRATION DATE WE SEND TO YOU A NOTICE BY REGISTERED OR CERTIFIED MAIL OR OVERNIGHT COURIER SERVICE AT THE ABOVE ADDRESS THAT THIS LETTER OF CREDIT WILL NOT BE EXTENDED BEYOND THE THEN CURRENT EXPIRATION DATE. IN NO EVENT SHALL THIS LETTER OF CREDIT BE AUTOMATICALLY EXTENDED BEYOND FEBRUARY 28, 2031. IN THE EVENT WE SEND SUCH NOTICE OF NON-EXTENSION, YOU MAY DRAW HEREUNDER BY YOUR PRESENTATION TO US OF YOUR SIGNED AND DATED STATEMENT STATING THAT YOU HAVE RECEIVED A NON-EXTENSION NOTICE FROM SILICON VALLEY BANK IN RESPECT OF LETTER OF CREDIT NO. SVBSF____, YOU ARE DRAWING ON SUCH LETTER OF CREDIT FOR US$___, AND YOU HAVE NOT RECEIVED A REPLACEMENT LETTER OF CREDIT ACCEPTABLE TO YOU.

ALL DEMANDS FOR PAYMENT SHALL BE MADE BY PRESENTATION OF THE REQUIRED DOCUMENTS ON A BUSINESS DAY AT OUR OFFICE (THE "BANK'S OFFICE") AT: SILICON VALLEY BANK, 3003 TASMAN DRIVE, MAIL SORT HF 210, SANTA CLARA, CA 95054, ATTENTION: GLOBAL TRADE FINANCE. AS USED IN THIS LETTER OF CREDIT, "BUSINESS DAY" SHALL MEAN ANY DAY OTHER THAN A SATURDAY, SUNDAY OR A DAY ON WHICH BANKING INSTITUTIONS IN THE STATE OF CALIFORNIA ARE AUTHORIZED OR REQUIRED BY LAW TO CLOSE.

FACSIMILE PRESENTATIONS ARE ALSO PERMITTED. SHOULD BENEFICIARY WISH TO MAKE A PRESENTATION UNDER THIS LETTER OF CREDIT ENTIRELY BY FACSIMILE TRANSMISSION IT NEED NOT TRANSMIT THE ORIGINAL OF THIS LETTER OF CREDIT AND AMENDMENTS, IF ANY. EACH FACSIMILE TRANSMISSION

SHALL BE MADE AT: (408) 496-2418 OR (408) 969-6510; AND UNDER CONTEMPORANEOUS TELEPHONE ADVICE TO: (408) --- ---- OR (408) ,
ATTENTION: GLOBAL TRADE FINANCE. ABSENCE OF THE AFORESAID TELEPHONE ADVICE SHALL NOT AFFECT OUR OBLIGATION TO HONOR ANY DRAW REQUEST.

THIS LETTER OF CREDIT IS TRANSFERABLE IN WHOLE BUT NOT IN PART ONE OR MORE TIMES, BUT IN EACH INSTANCE ONLY TO A SINGLE BENEFICIARY AS TRANSFEREE AND FOR THE THEN AVAILABLE AMOUNT, ASSUMING SUCH TRANSFER TO SUCH TRANSFEREE WOULD BE IN COMPLIANCE WITH THEN APPLICABLE LAW AND REGULATION, INCLUDING BUT NOT LIMITED TO THE REGULATIONS OF THE U.S. DEPARTMENT OF TREASURY AND U.S. DEPARTMENT OF COMMERCE. AT THE TIME OF TRANSFER, THE ORIGINAL LETTER OF CREDIT AND ORIGINALS OR COPIES OF ALL AMENDMENTS, IF ANY, TO THIS LETTER OF CREDIT MUST BE SURRENDERED TO US AT OUR ADDRESS INDICATED IN THIS LETTER OF CREDIT TOGETHER WITH OUR TRANSFER FORM ATTACHED HERETO AS EXHIBIT A DULY EXECUTED. APPLICANT SHALL PAY OUR TRANSFER FEE OF ¼ OF 1% OF THE TRANSFER AMOUNT (MINIMUM US$250.00) UNDER THIS LETTER OF CREDIT. HOWEVER, APPLICANT'S PAYMENT OF SUCH TRANSFER FEE SHALL NOT BE A CONDITION OF SUCH TRANSFER. EACH TRANSFER SHALL BE EVIDENCED BY EITHER (1) OUR ENDORSEMENT ON THE REVERSE OF THE LETTER OF CREDIT AND WE SHALL FORWARD THE ORIGINAL OF THE LETTER OF CREDIT SO ENDORSED TO THE TRANSFEREE OR (2) OUR ISSUING A REPLACEMENT LETTER OF CREDIT TO THE TRANSFEREE ON SUBSTANTIALLY THE SAME TERMS AND CONDITIONS AS THE TRANSFERRED LETTER OF CREDIT (IN WHICH EVENT THE TRANSFERRED LETTER OF CREDIT SHALL HAVE NO FURTHER EFFECT).

IF ANY INSTRUCTIONS ACCOMPANYING A DRAWING UNDER THIS LETTER OF CREDIT REQUEST THAT PAYMENT IS TO BE MADE BY TRANSFER TO YOUR ACCOUNT WITH ANOTHER BANK, WE WILL ONLY EFFECT SUCH PAYMENT BY FED WIRE TO A U.S. REGULATED BANK, AND WE AND/OR SUCH OTHER BANK MAY RELY ON AN ACCOUNT NUMBER SPECIFIED IN SUCH INSTRUCTIONS EVEN IF THE NUMBER IDENTIFIES A PERSON OR ENTITY DIFFERENT FROM THE INTENDED PAYEE.

THIS LETTER OF CREDIT IS SUBJECT TO THE INTERNATIONAL STANDBY PRACTICES (ISP98), INTERNATIONAL CHAMBER OF COMMERCE, PUBLICATION NO. 590.

AUTHORIZED SIGNATURE AUTHORIZED SIGNATURE

IRREVOCABLE STANDBY LETTER OF CREDIT NUMBER __

EXHIBIT A

FORM OF TRANSFER FORM

DATE: __

TO: SILICON VALLEY BANK
3003 TASMAN DRIVE RE: IRREVOCABLE STANDBY LETTER OF CREDIT
SANTA CLARA, CA 95054 NO.__ISSUED BY
ATTN: GLOBAL TRADE FINANCE SILICON VALLEY BANK, SANTA CLARA STANDBY LETTERS OF CREDIT L/C AMOUNT: __

GENTLEMEN:

FOR VALUE RECEIVED, THE UNDERSIGNED BENEFICIARY HEREBY IRREVOCABLY TRANSFERS TO:

(NAME OF TRANSFEREE)

(ADDRESS)

ALL RIGHTS OF THE UNDERSIGNED BENEFICIARY TO DRAW UNDER THE ABOVE LETTER OF CREDIT UP TO ITS AVAILABLE AMOUNT AS SHOWN ABOVE AS OF THE DATE OF THIS TRANSFER.

BY THIS TRANSFER, ALL RIGHTS OF THE UNDERSIGNED BENEFICIARY IN SUCH LETTER OF CREDIT ARE TRANSFERRED TO THE TRANSFEREE. TRANSFEREE SHALL HAVE THE SOLE RIGHTS AS BENEFICIARY THEREOF, INCLUDING SOLE RIGHTS RELATING TO ANY AMENDMENTS, WHETHER INCREASES OR EXTENSIONS OR OTHER AMENDMENTS, AND WHETHER NOW EXISTING OR HEREAFTER MADE. ALL AMENDMENTS ARE TO BE ADVISED DIRECTLY TO THE TRANSFEREE WITHOUT NECESSITY OF ANY CONSENT OF OR NOTICE TO THE UNDERSIGNED BENEFICIARY.

THE ORIGINAL OF SUCH LETTER OF CREDIT IS RETURNED HEREWITH, AND WE ASK YOU TO EITHER (1) ENDORSE THE TRANSFER ON THE REVERSE THEREOF, AND FORWARD IT DIRECTLY TO THE TRANSFEREE WITH YOUR CUSTOMARY NOTICE OF TRANSFER, OR (2) ISSUE A REPLACEMENT LETTER OF CREDIT TO THE TRANSFEREE ON SUBSTANTIALLY THE SAME TERMS AND CONDITIONS AS THE TRANSFERRED LETTER OF CREDIT (IN WHICH EVENT THE TRANSFERRED LETTER OF CREDIT SHALL HAVE NO FURTHER EFFECT).

SINCERELY,

SIGNATURE AUTHENTICATED

The name(s), title(s), and signature(s) conform to that/those on file with us for the company and the signature(s) is/are authorized to execute this instrument.

(Name of Bank) (Address of Bank) (City, State, ZIP Code)

(Authorized Name and Title)

(Authorized Signature) (Telephone number)

(BENEFICIARY'S NAME)

(SIGNATURE OF BENEFICIARY)

(NAME AND TITLE)

EXHIBIT 7 LANDLORD'S SERVICES

1. Hot and cold water to the common area lavatories, and cold water to the Premises
2. Electricity for building common areas
3. HVAC services to the Building common areas and the Premises (but excepting those areas served by HVAC solely dedicated to any tenant)
5. Elevator service
6. Trash removal
7. Snow removal
8. Exterior grounds and parking maintenance
9. Management services
10. Building security systems and services
11. Maintenance of life safety systems (fire alarm and sprinkler)
12. Such other services as Landlord reasonably determines are necessary or appropriate for the Property

EXHIBIT 8 [INTENTIONALLY OMITTED]

A. General

EXHIBIT 9-1

BUILDING RULES AND REGULATIONS

75 HAYDEN AVENUE, LEXINGTON, MA

1. Tenant and its employees shall not in any way obstruct the sidewalks, halls, stairways, or exterior vestibules of the Building, and shall use the same only as a means of passage to and from their respective offices. At no time shall Tenants permit its employees, contractors, or other representatives to loiter in Common Areas or elsewhere in and about the Property.

2. Corridor doors, when not in use, shall be kept closed.

3. Areas used in common by tenants shall be subject to such regulations as are posted therein.

4. Any Tenant or vendor sponsored activity or event in the Common Area must be approved and scheduled through Landlord's representative, which approval shall not be unreasonably withheld.

5 No animals, except Seeing Eye dogs, shall be brought into or kept in, on or about the Premises or Common Areas, except as approved by Landlord.

6. Alcoholic beverages (without Landlord's prior written consent which shall not be unreasonably withheld, conditioned or delayed), illegal drugs or other illegal controlled substances are not permitted in the Common Areas, nor will any person under the influence of the same be permitted in the Common Areas. Landlord reserves the right to exclude or expel from the Building any persons who, in the judgment of the Landlord, is under the influence of alcohol or drugs, or shall do any act in violation of the rules and regulations of the Building.

7. No firearms or other weapons are permitted in the Common Areas.

8. No fighting or "horseplay" will be tolerated at any time in the Common Areas.

9. Tenant shall not cause any unnecessary janitorial labor or services in the Common Areas by reason of Tenant's carelessness or indifference in the preservation of good order and cleanliness.

10. Smoking and discarding of smoking materials by Tenant and/or any Tenant Party is permitted only in exterior locations designated by Landlord. Tenant will instruct and notify its employees and visitors of such policy.

11. Bicycles and other vehicles are not permitted inside or on the walkways outside the Building, except in those areas specifically designated by Landlord for such purposes

12. Tenant shall not operate or permit to be operated on the Premises any coin or token operated vending machine or similar device (including, without limitation, telephones, lockers, toilets, scales, amusement devices and machines for sale of beverages food, candy, cigarettes or other goods), except for those vending machines or similar devices which are for the sole and exclusive use of tenant's employees and located within the Tenant Premises.

13. Canvassing, soliciting, and peddling in or about the Building is prohibited. Tenant, its employees, agents and contractors shall cooperate with said policy, and Tenant shall cooperate and use best efforts to prevent the same by Tenant's invitees.

14. Fire protection and prevention practices implemented by the Landlord from time to time in the Common Areas, including participation in fire drills, must be observed by Tenant at all times.

15. Except as provided for in the Lease, no signs, advertisements or notices shall be painted or affixed on or to any windows, doors or other parts of the Building that are visible from the exterior of the Building unless approved in writing by the Landlord.

16. The restroom fixtures shall be used only for the purpose for which they were constructed and no rubbish, ashes, or other substances of any kind shall be thrown into them. Tenant will bear the expense of any damage resulting from misuse.

17. Tenant will not interfere with or obstruct any building central HVAC, electrical, or plumbing systems.

18. Tenant shall utilize the pest control service designated by Landlord to control pests in the Premises. Except as included in Landlord's Services, tenants shall bear the cost and expense of such pest control services.

19. Tenant shall not install, operate or maintain in the Premises or in any other area of the Building, any electrical equipment which does not bear the U/L (Underwriters Laboratories) seal of approval, or which would overload the electrical system or any part thereof beyond its capacity for proper, efficient and safe operation as determined by Landlord, taking into consideration the overall electrical system and the present and future requirements of the Building. The capacity of the electrical system is listed on Exhibit 5 attached hereto.

20. Tenants shall not use more than its proportionate share of telephone lines available to service the Building.

21. Tenants shall not perform improvements or alterations within the Building or their Premises, if the work has the potential of disturbing the fireproofing which has been applied on the surfaces of structural steel members, without the prior written consent of Landlord, subject to the provisions of the Lease.

22. Tenant shall manage its waste removal and janitorial program, at its sole cost and expense, keeping any recyclables, garbage, trash, rubbish and refuse in vermin proof containers for Tenants sole use within the Landlord designated area until removed with all work to be performed during non-business hours.

23. Lab operators who travel outside lab space must abide by the one glove rule and remove lab coats where predetermined.

24. To the extent required by the Chemical Safety Program, chemical lists and MSDS sheets must be readily available at the entrance to each lab area. In the event of an emergency, first responders will require this information in order to properly evaluate the situation.

25. Tenant shall provide Landlord, in writing, the names and contact information of two (2) representatives authorized by Tenant to request Landlord services, either billable or non- billable and to act as a liaison for matters related to the Premises.

26. Parking of any trailers, trucks, motor homes, or unregistered vehicles in the parking lots is prohibited.

27. Tenants shall not use more than its proportionate share of Base Building Central HVAC or electrical capacity, subject to the provisions of the lease.

B. Access & Security

1. Landlord reserves the right to close and keep locked all entrance and exit doors of the Building during the hours Landlord may deem advisable for the adequate protection of the Property. Use of the Building and the leased Premises before 8 AM or after 6 PM, or any time during Saturdays, Sundays or legal holidays shall be allowed only to persons with a key/card key to the Building or guests accompanied by such persons. Any persons found in the Building after hours without such keys/card keys are subject to the surveillance of building staff.

2. Tenant shall not place any additional lock or locks on any exterior door in the Premises or Building or on any door in the Building core within the Premises, including doors providing access to the telephone and electric closets and the slop sink, without Landlord's prior written consent. A reasonable number of keys to the locks on the doors in the Premises shall be furnished by Landlord to Tenant at the cost of Tenant, and Tenant shall not have any duplicate keys made. All keys shall be returned to landlord at the expiration or earlier termination of this Lease.

3. Landlord may from time to time adopt appropriate systems and procedures for the security or safety of the Building, its occupants, entry and use, or its contents, provided that Tenant shall have access to the Building 24 hours per day, 7 days a week. Tenant, Tenant's agents, employees, contractors, guests and invitees shall comply with Landlord's reasonable requirements relative thereto.

4. Tenant acknowledges that Property security problems may occur which may require the employment of extreme security measures in the day-to-day operation of the Common Areas. Accordingly, Tenant agrees to cooperate and cause its employees, contractors, and other representatives to cooperate fully with Landlord in the implementation of any reasonable security procedures concerning the Common Areas.

5. Tenant and its employees, agents, contractors, invitees and licensees are limited to the Premises and the Common Areas. Tenants and its employees, agents, contractors, invitees and

licensees may not enter other areas of the Project (other than the Common Areas) except when accompanied by an escort from the Landlord.

C. Shipping/Receiving

1. Dock areas for the Building shall not be used for storage or staging by Tenant except in the Loading Dock Premises as permitted in the Lease.

2. In no case shall any truck or trailer be permitted to remain in a loading dock area for more than 60 minutes, except with prior written notice to Landlord, which notice may be given via email, provided that, in any event Landlord shall have the right, in good faith, to require Tenant to adjust its schedule for the use of the dock areas based upon the needs of the other tenants of the Building and Building operations.

3. There shall not be used in any Common Area, either by Tenant or by delivery personnel or others, in the delivery or receipt of merchandise, any hand trucks, except those equipped with rubber tires and sole guards.

4. Lab operators carrying any lab related materials may only travel within the Premises. At no time should any lab materials travel in the Common Areas, except at the Loading Dock and Freight Elevator.

5. Any dry ice brought into the building must be delivered through the loading dock.

6. All nitrogen tanks must travel through the loading dock and should never be left unattended outside of the Premises.

LINCOLN PROPERTY COMPANY TENANT CONSTRUCTION
BUILDING RULES AND REGULATIONS

THE RULES MUST BE POSTED AT THE JOB SITE AT ALL TIMES!

1. Parking. Parking areas are designated by the Management Office and are subject to change at any time. Construction personnel are required to park in the parking areas designated by the Management Office. Failure to adhere to this regulation will result in the towing of the vehicle in violation at the owner's expense.

2. Access. Building entrances; lobbies, passages, corridors, public elevators, stairways, and other common areas may not be encumbered, or obstructed by the contractor, or contractor's agents during construction of the tenant's lease premises. Material deliveries must be scheduled in advance through the Management Office and coordinated with the Lincoln Property Company representative. Contractors are not to use Tenant phones, or Restrooms under any circumstances. Construction personnel found using phones, or restrooms located in the tenant's suite will be asked to immediately leave the premises and will not be allowed to return.

3. Each contractor is responsible for their subcontractor(s), and for the actions of their personnel including clean-up of work and construction traffic. No alcoholic beverages, glass containers, or "controlled substances" are allowed on the premises. All work must be scheduled through the Management Office and include a list of contractors performing work prior to the start of the work. After-hours work must be scheduled through the Management Office 24 hours before the activity will occur. Weekend activity must be scheduled by Friday at 9 a.m. Contractors will not be allowed to work in the Building after hours, or on weekends unless the procedures outlined above have been followed.

   All after-hours work must be supervised by the general contractor. There will be no exceptions to this rule.

   Prior to the commencement and upon completion of each job, a walk-through of public areas will be made, i.e. restrooms, etc., and any subsequent damages will be the responsibility of the contractor. The contractor shall be responsible for cleaning the assigned restrooms each day at his own expense.

4. Noise and Vapor Restrictions. Any work that would cause inconvenience to other tenants in the Building, or that must be done in an occupied space must be done after hours or on the weekend. Structural modifications, floor penetrations created with the use of core drilling machines, pneumatic hammers, etc., shall be performed before 7:30 a.m. or after

7:00 p.m. Likewise, any construction operations causing excessive noise, dust, vapors must be conducted during these hours.

When construction is on an occupied multi-tenant floor, noise, i.e., radios, loud talking, noise from equipment, etc., must be kept to a minimum. On these multi-tenant floors, public restrooms are not to be used by contractors.

A Lincoln Property Company superintendent, or the Property Manager will have the sole authority to determine if an operation is causing excessive noise, dust, or vapors.

5. Lincoln Property Company has the right to inspect work at any time and may reject work that does not conform to code, tenant's plans, or work that may affect the exterior appearance, structural components, or service system of the building.

6. Mechanical and electrical shop drawings must be reviewed and approved by Landlord's approved engineer. Prior to starting work, the general, mechanical, and electrical contractors must review the work with the Facilities Manager and Facilities Supervisor.

   All panels and transformers are to match the building standard systems and all materials and methods used to connect panels and transformers must be approved by Landlord.

   Unscheduled outages of any utility, or building service is strictly prohibited.

7. Dust and air contamination are to be controlled with temporary partitions which are sealed adequately to prevent dust from entering leased areas or mechanical equipment. Floor sweep or a comparable material will be used when sweeping concrete or tile floors.

8. Clean-up of Common and Lease Areas. Premises must be kept in a clean, orderly fashion at all times and free of potential safety and fire hazards. A general clean-up of the space under construction is to be performed on a daily basis. Final clean-up will be the responsibility of the contractor, which is to include all vacuuming and dusting as required. Failure to adequately keep the work area clean and accessible will result in Lincoln Property Company using its own forces to achieve this through whatever means determined necessary, and the total cost will be deducted from the contract.

9. Trash Removal. Contractor is responsible for removing all construction debris and trash from the construction site. UNDER NO circumstances shall trash, or construction debris be allowed to accumulate. Trash removal must be coordinated through the Lincoln Property Company Management Office. No vehicles, or dumpsters will be allowed to remain stationary on the site.

   Under no circumstances is the Landlord's dumpster to be used.

10. If any fire sprinkler work, or modification to the fire sprinkler system is required, the system must be back in operation at the end of the work day. Under no circumstances shall the fire sprinkler system be left inoperative overnight. The facilities manager must be notified each morning of the location of and type of sprinkler work to be performed. The

engineer hourly rate of $75.00 will be charged for routine work and/or extended regular hour work.

11. Existing pull stations and horns and strobes located throughout the Building will remain live during construction.

12. It shall be the responsibility of the general contractor to complete all punch list items before the tenant move-in date or the stipulated completion date.

13. All construction staging, storage, and temporary contractor facilities will be located in specific areas assigned by the Lincoln Property Company. Contractors will be responsible for the maintenance, housekeeping, and demolition of all temporary facilities.

14. Any removal, replacement, or repair work to a base building system to accommodate work directed by the tenant, or unforeseen interference (i.e., sprinkler head conflicts) which is not part of the Work, will be performed by the tenant's contractor at tenant's sole expense.

15. No fire arms or weapons are permitted on the property.

16. Insurance. Contractors will be required to carry standard requirements incorporating both the owner and LPC Commercial Services, Inc. as additionally insured parties.

17. At no time is any welding, or cutting with a torch to be used in the building without prior approval and coordination from the Management Office. Hot work permits may be required depending on the status of the project for all hot work including welding, soldering, and torch cutting. All hot work requires a fire extinguisher supplied by the contractor and must be in the immediate vicinity and easily accessible. Fire extinguishers must be inspected at least monthly.

18. A copy of these regulations shall be posted on the job site for all parties to observe. Contractor is responsible for instructing all of his personnel, subcontractors and supplies to comply with these regulations.

19. ALL PASSENGER ELEVATORS AND PUBLIC AREAS SHALL BE RESTRICTED AND OFF LIMITS TO ALL CONSTRUCTION PERSONNEL. Under no circumstances shall the exit stairwells be used for access to/from the first floor. All construction personnel for this project shall only use the freight elevator from the first floor back lobby. Under no circumstances shall the main entrance to the Building or the garage passenger elevators be used for access.

    All deliveries of materials and equipment must be scheduled at least twenty-four (24) hours prior to their delivery through the Lincoln Property Company Management Office. The contractor will be provided access to the freight elevator to be used in the "independent mode" for after-hours deliveries. The Contractor shall provide an operator during work hours to ensure correct and safe usage. Contractor shall keep the elevator cab and door tracks clean and free of all debris. Contractor shall be responsible for repair costs incurred due to misuse or damage caused by his forces. All major deliveries must be made between the hours of 11:00 p.m. to 7:00 a.m. Monday through Friday and all day long on Saturday

and Sunday. Contractor will be charged for having an engineer on duty to assist with deliveries when the loading dock is closed. Additional charges incurred due to non- standard elevator use (i.e., moving freight on top of elevator cab) shall be paid by the General Contractor.

Your signature below signifies that you have read the rules above and agree to abide by all of them.

Signature	Date	Firm Name

Effective Date:

EXHIBIT 10

TENANT WORK INSURANCE SCHEDULE

Tenant shall, at its own expense, maintain and keep in force, or cause to be maintained and kept in force by any general contractors, sub-contractors or other third party entities where required by contract, throughout any period of alterations to the Premises or the Building by Tenant, the following insurance coverages:

(1) Property Insurance. "All-Risk" or "Special" Form property insurance, and/or Builders Risk coverage for major renovation projects, including, without limitation, coverage for fire, earthquake and flood; boiler and machinery (if applicable); sprinkler damage; vandalism; malicious mischief coverage on all equipment, furniture, fixtures, fittings, tenants work, improvements and betterments, business income, extra expense, merchandise, inventory/stock, contents, and personal property located on or in the Premises. Such insurance shall be in an amount equal to the full replacement cost of the aggregate of the foregoing and shall provide coverage comparable to the coverage in the standard ISO "All-Risk" or "Special" form, when such coverage is supplemented with the coverages required above. Property policy shall also include coverage for Plate Glass, where required by written contract.

Builders Risk insurance coverage may be provided by the general contractor on a blanket builders risk policy with limits adequate for the project, and evidencing the additional insureds as required in the Lease.

(2) Liability Insurance. General Liability, Umbrella/Excess Liability, Workers Compensation and Auto Liability coverage as follows:

(a) General Liability	$1,000,000 per occurrence $1,000,000 personal & advertising injury $2,000,000 products/completed operations aggregate

The General Contractor is required to maintain, during the construction period and up to 3 years after project completion, a General Liability insurance policy, covering bodily injury, personal injury, property damage, completed operations, with limits to include a $1,000,000 limit for blanket contractual liability coverage and adding Landlord as additional insured as respects the project during construction and for completed operations up to 3 years after the end of the project. Landlord requires a copy of the ISO 20 10 11 85 Additional Insured endorsement, showing Landlord as an additional insured to the GC's policy.

(b) Auto Liability	$1,000,000 combined single limit (Any Auto) for bodily injury and property damage, hired and non-owned cover.
(c) Workers Compensation	Statutory Limits
Employers Liability	$1,000,000 each accident* $1,000,000 each employee* $1,000,000 policy limit*

* or such amounts as are customarily obtained by operators of comparable businesses

General Contractor shall ensure that any and all sub-contractors shall maintain equal limits of coverage for Workers Compensation/EL and collect insurance certificates verifying same.

(d) Umbrella/Excess Liability	$25,000,000 per occurrence
(e) Environmental Insurance	To the extent required by Landlord Contractors' commercial general liability/umbrella insurance policy(ies) shall include Landlord and Landlord's designees as additional insureds', and shall include a primary non-contributory provision. Liability policy shall contain a clause that the insurer may not cancel or materially change coverage without first giving Landlord thirty (30) days prior written notice, except cancellation for non-payment of premium, in which ten (10) days prior written notice shall be required.

(3) Deductibles. If any of the above insurances have deductibles or self-insured retentions, the Tenant and/or contractor (policy Named Insured) shall be responsible for the deductible amount.

All of the insurance policies required in this Exhibit 10 shall be written by insurance companies which are licensed to do business in the State where the property is located, or obtained through a duly authorized surplus lines insurance agent or otherwise in conformity with the laws of such state, with an A.M. Best rating of at least A and a financial size category of not less than
VII. Tenant shall provide Landlord with certificates of insurance upon request, prior to commencement of the Tenant/contractor work, or within thirty (30) days of coverage inception and subsequent renewals or rewrites/replacements of any cancelled/non-renewed policies.

EXHIBIT 11

[Intentionally Omitted]

EXHIBIT 12

PLAN—LOADING DOCKS, RECEPTION AREA, AND FREIGHT ELEVATORS

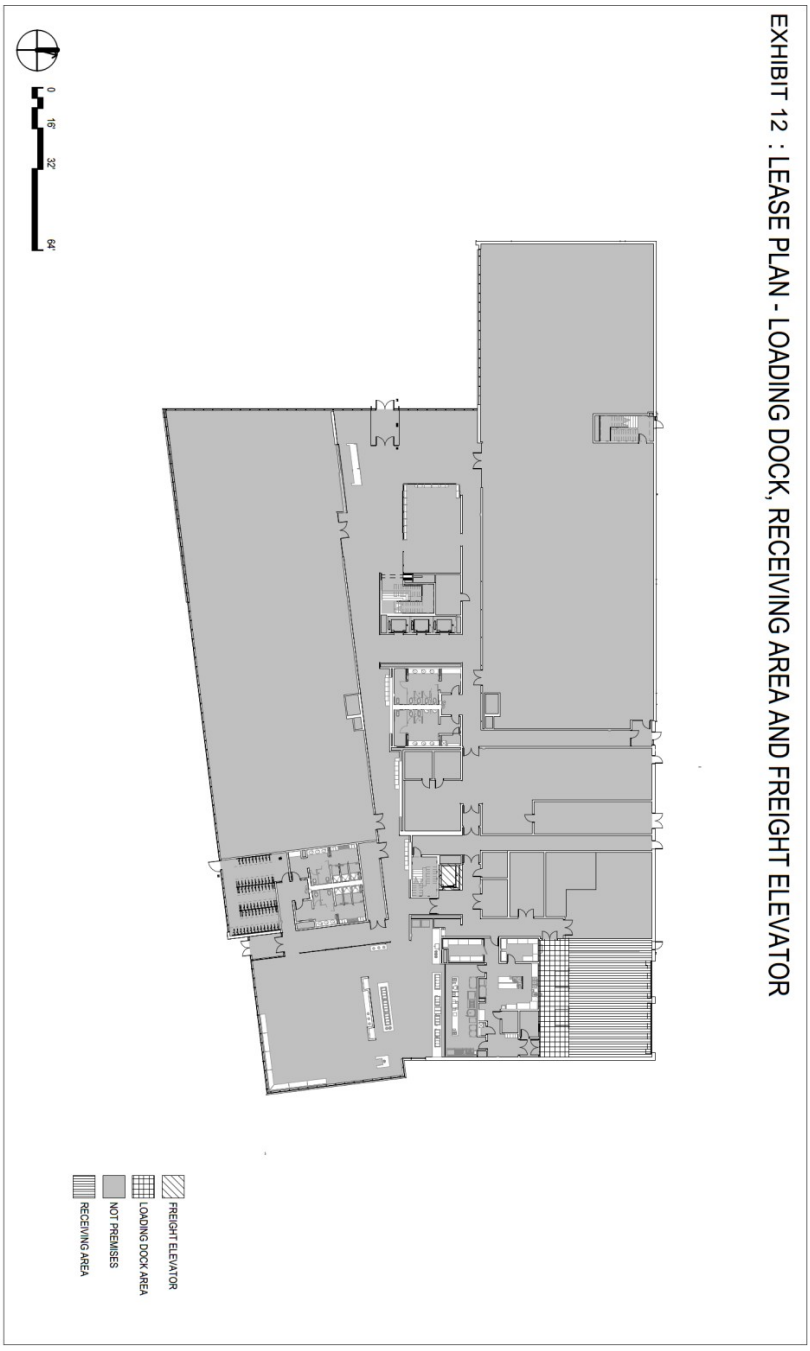


Exhibit 10.54

EMPLOYMENT AGREEMENT

EMPLOYMENT AGREEMENT ("Agreement") made this 3rd of June 2019 (the "Effective Date") between Dicerna Pharmaceuticals, Inc., a Delaware corporation ("Company"), on the one hand and Robert Ciappenelli (the "Executive") on the other hand.

WHEREAS, the Company desires to employ the Executive and the Executive desires to be employed by the Company, on terms set forth herein;

NOW, THEREFORE, in consideration of the mutual agreements set forth herein, the parties agree as follows:

1. Term of Employment. The Executive's employment under this Agreement shall commence on the Effective Date and shall end on such date as the Executive's employment terminates in accordance with Section 4 of this Agreement. Subject to the balance of this Agreement, the Executive shall be an at-will employee of the Company whose employment may be terminated (by the Company or by the Executive) at any time, for any or no reason, in which case the Executive will be entitled to the separation benefits set forth in Section 4, below.

2. Duties. During his employment with the Company, the Executive shall have the title of Chief Commercial Officer. The Executive shall devote his full business time and effort to the performance of his duties for the Company, which he shall perform faithfully and to the best of his ability. The Executive shall have all of the customary powers and duties associated with his position and shall be subject to the Company's policies, procedures, and approval practices, as generally in effect from time to time for all senior executives of the Company and the direction and oversight of the Board. The Executive will report directly to the President and CEO of the Company.

3. Compensation and Related Matters.

a. Base Salary. The Company shall pay the Executive base salary at a rate of $15,625 paid twice monthly (which annualizes to $375,000), less withholdings and deductions required and/or permitted by law. The Executive's base salary shall be paid in conformity with the Company's payroll practices generally applicable to the Company' s senior executives.

b. Annual Bonus. The Executive shall be eligible to be considered for an Annual Bonus upon achieving of certain pre-determined performance targets consistent with any Incentive Compensation Plan established by the Compensation Committee (the "Committee"). The Annual Bonus shall be based, in part, on the Executive's performance. The grant of such a bonus shall be in the sole discretion of the Committee. The maximum bonus amount for which the Executive will be eligible is forty percent (40%) of base salary earned for the calendar year. The Annual Bonus will be earned only after it has been granted by the Committee. The Annual Bonus shall be paid to the Executive following the close of the fiscal year to which it relates, in no event later than March 15th of the calendar year immediately following the calendar year in which it was earned. The Executive must be actively employed by the Company at the time the Committee considers granting of bonuses to be eligible to receive such bonus.

c. Equity Compensation. Subject to the approval of the Board or an appropriate committee thereof, the Executive shall be eligible for a stock option grant (the "Grant") to purchase in total up to 300,000 shares of the Company's Common Stock at an exercise price equal to the fair market value of each share on the date of grant as determined by the Board or an appropriate committee thereof. The Grant shall vest in accordance with the following schedule: 25% of the shares underlying the Grant will vest on the twelve (12) month anniversary of Executive's commencement of ful1-time employment with the Company and the remaining shares will vest and become exercisable on a pro rata, monthly basis thereafter on the same day of the month as the vesting commencement date (or if there is no corresponding day, on the last day of the month), such that

all shares underlying the Grant shall have vested on the fourth anniversary of the vesting commencement date. Vesting of the Grant will be subject to Executive's continued status as a service provider with the Company at each such vesting period. The Grant will be subject to the terms of a stock plan and a stock option agreement that the Company and Executive will be required to execute. Except as otherwise provided in an award agreement between the Executive and the Company, any equity awards granted to the Executive shall vest in full upon a Change of Control of the Company (as defined below).

d. Benefits. During his employment with the Company, the Executive shall be entitled to participate in
All employee benefit plans and programs, including paid sick leave and holidays, life insurance, disability, medical, dental, and retirement savings plans, to the same extent generally available to senior executives of the Company, in accordance with the terms of those plans and programs. The Executive shall be permitted up to four weeks of paid vacation per year, which will accrue on a monthly basis. The Executive will not be allowed to accumulate more than three weeks of unused vacation days at any given time. The Executive may carry over a maximum of five unused vacation days from one calendar year to the next.

e. Expenses. The Company agrees to reimburse the Executive for reasonable out-of-pocket expenses incurred in connection with Company business and within standards to be established by the Board from time to time, including, without limitation, travel and accommodations for authorized business trips, provided vouchers therefore, or other supporting information as the Company may reasonably require, are presented to the Company. All reimbursements provided under this Agreement shall be made or provided in accordance with the requirements of Section 409A of the Internal Revenue Code of 1986, as amended (the "Code") and the rules and regulations thereunder ("Section 409A") including, where applicable, the requirement that (i) any reimbursement is for expenses incurred during the Executive's lifetime (or during a shorter period of time specified in this Agreement); (ii) the amount of expenses eligible for reimbursement during a calendar year may not affect the expenses eligible for reimbursement in any other calendar year; (iii) the reimbursement of an
eligible expense shall be made no later than the last day of the calendar year following the year in which the expense is incurred; and (iv) the right to reimbursement or in-kind benefits is not subject to liquidation or exchange for another benefit.

4. Termination

a. Rights and Duties. The Executive is an employee "at will." Accordingly, the Company or the Executive may terminate his employment, at any time with or without cause, for any lawful reason, or no reason. The Executive and the Company agree that, without modifying or altering the Executive's "at will" status, each will provide the other with at least thirty (30) days' prior written notice of termination of the Executive's employment with the Company. If the Executive gives notice of termination, except in the case of a termination by the Executive for "Good Reason" as set forth below, such notice will be deemed a voluntary resignation by the Executive and the Company, in its sole discretion, may elect to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, without changing the status of such termination as a voluntary resignation by the Executive. Should the Company in the event of a voluntary resignation decide to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, it shall nonetheless continue his compensation and benefits for the term of the notice period, except that no bonus shall be earned or awarded during and after the notice period.

b. Termination for "Good Reason." The Executive may terminate his employment at any time for "Good Reason." "Good Reason" shall comport with the requirements of Regulation §1.409A l(n)(2)(ii) and shall mean:

i. A material diminution in the Executive's authority, duties, responsibilities or reporting responsibilities;

ii. A material diminution by the Company of the Executive's annual base compensation then

in effect, except a material diminution generally affecting the members of the Company's management;

iii. Any action or inaction by the Company that constitutes a material breach by the Company of the terms of this Agreement; or

iv. A requirement that the Executive be based more than 50 miles from the offices at which he was principally employed immediately prior to the date of termination.

The parties acknowledge and agree that "Good Reason" shall not be deemed to have occurred unless: (1) the Executive provides the Company with written notice that he intends to terminate his employment hereunder for one of the Good Reason grounds set forth in Section 4.b. within sixty (60) days of the initial occurrence of such ground, with such notice containing a description of such ground, (2) if such Good Reason ground is capable of being cured, the Company has failed to cure such ground within a period of thirty (30) days from the date of such written notice, and (3) the Executive terminates his employment within ninety-one (91) days from the date that such Good Reason ground first occurs. For purposes of clarification, the above listed conditions shall apply separately to each occurrence of a Good Reason ground, and failure to adhere to such conditions in the event of the occurrence of grounds that would otherwise have constituted Good Reason had the conditions herein been satisfied shall not disqualify the Executive from asserting and satisfying the conditions for Good Reason for any subsequent occurrence that may constitute Good Reason.

c. Termination by the Company for Cause. The Company may terminate the Executive's employment at any time for "Cause." "Cause" shall mean:

i. The Executive's commission of an act of fraud, dishonesty, breach of fiduciary duty or misappropriation which may or does adversely affect the Company;

ii. The Executive's conviction or plea of guilty or *nolo contendere* to or engaging in any felony or crime involving moral turpitude, fraud, misrepresentation or other crime and/or indictment for a crime that, in the reasonable opinion of the Company, affects the Executive's ability to perform the duties set forth in this Agreement and/or reflects negatively upon the Company;

iii. Unauthorized disclosure by the Executive of the Company's Proprietary Information, as defined in the Nondisclosure Agreement (as defined in Section 5 below), which results or could have been reasonably foreseen to result, in a material financial loss to the Company;

iv. The Executive's material breach of this Agreement or the Nondisclosure Agreement; provided, that if such breach is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such breach to cure; or

v. The Executive's failure (which shall not include any Disability as defined below) or refusal to perform the duties and responsibilities of his employment and/or to follow the policies and procedures of the Company, including without limitation the failure or refusal to carry out lawful instructions from the Board. If such failure or refusal is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such failure or refusal to cure.

d. Termination in the Event of Death or Disability. The Agreement shall terminate upon the Executive's death or Disability, and the Executive's employment with the Company shall thereupon terminate. For purposes of the Agreement, "Disability" is defined as any illness, injury, accident or condition of either a physical or psychological nature as a result of which the Executive is unable to perform the essential functions of his duties and responsibilities hereunder for 90 days during any period of 365 consecutive calendar days or for any consecutive 90-day period.

e. Effect of Termination.

i. If the Executive is terminated by the Company for Cause, or by the Executive voluntarily

other than for Good Reason, then the Executive will only be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued but unused prior to termination of employment.

ii. If the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of

employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.v. below, the following:

a) Continuation of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination for a twelve (12) month period, payable in accordance with the Company's regular payroll practices, less applicable withholdings, commencing at the conclusion of the Review Period (as described below), *provided* that the first installment of such payments shall include all amounts which would have been paid during the period between the Executive's date of termination and the date of such first installment;

b) Payment of a pro-rata portion of the actual amount of the Executive's Annual Bonus based on actual performance determined under the terms of the Company's annual bonus program as then in effect, with such pro-rata portion calculated by multiplying the actual amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made after the determination of the bonus funding level (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs); and

c) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) twelve (12) months or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA.

iii. If the Agreement is terminated because of the Executive's death, the Company shall pay to the estate of the Executive the salary and benefits which would otherwise have been payable to the Executive up to the date of termination of his employment because of death.

iv. In the event a Change of Control (as defined below) occurs and, if within one (1) year thereafter, the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.v. below, the following:

a) A lump sum payment equal to the sum of (i) one (1) year of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination, less applicable withholdings, plus (ii) the Executive's target annual bonus for the year in which the termination occurs, less applicable withholdings, payable at the conclusion of the Review Period (as described below);

b) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) one (1) year or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA; and

c) Payment of a pro-rata portion of the target amount of the Executive's annual bonus, with such pro-rata portion calculated by multiplying the target amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made at the conclusion of the Review Period (but in no event later than March 15 of the calendar year following the year in which the Executive ' s termination occurs).

For purposes of this Agreement, "Change of Control" means (A) the occurrence of a merger or consolidation of the Company whether or not approved by the Board, other than (i) a merger or consolidation which would result in the voting securities of the Company outstanding immediately prior thereto continuing to represent (either by remaining outstanding or by being converted into voting securities of the surviving entity or the parent of such corporation) at least 50% of the total voting power represented by the voting securities of the Company or such surviving entity or parent of such corporation outstanding immediately after such merger or consolidation, or (ii) a merger or consolidation which is in effect a financing transaction for the Company, including, but not limited to, a reverse merger of the Company into a publicly traded "shell" company, or (B) the stockholders of the Company approve an agreement for the sale or disposition by the Company of all or substantial1y all of the Company's assets, provided that, in any case, "Change of Control" shall be in accordance with Regulation §l.409A-3(i)(5).

v. Payment of the severance pay and benefits described in Section 4.e. ii. or 4.e.iv., as applicable, is expressly conditioned on the Executive's execution without revocation of the separation agreement and general release described therein, within the time period prescribed in the separation agreement and general release (which release shall include, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days), and will commence immediately following a sixty (60) day period following the effective date of the Executive's separation from service from the Company (the "Review Period") (with the exception of the pro rata annual bonus payment described in Section 4.e.ii.b., which shall be payable after the bonus funding level is determined but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs). The separation agreement and general release will be provided to the Executive on or before the fifth (5th) day following such separation from service. If the Executive fails or refuses to return such agreement within the Review Period, the applicable severance payments and benefits will be forfeited. If the Executive is eligible for the severance pay and benefits described in Section 4.e.ii., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e. iv. Similarly, if

the Executive is eligible for the severance pay and benefits described in Section 4.e.iv., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e. ii.

5. Nondisclosure, Non-Solicitation and Assignment Agreement. As a condition of the Executive's employment by the Company and the payment of compensation and receipt of benefits referred to above, the Executive agrees to continue to be bound by the terms of the standard **Nondisclosure, Non-Solicitation and Assignment Agreement,** entered into by the Executive as of June 3, 2019 (the "Nondisclosure Agreement"). The Executive acknowledges that the Company would not offer him employment or provide compensation and/or benefits set forth above if he was not willing to be bound by the terms of such Nondisclosure Agreement.

6. Notice.

a. To the Company. The Executive will send all communications to the Company in writing, addressed as follows (or in any other manner the Company notifies him to use):

CEO

With a copy to:

Douglas M. Fambrough III, Ph.D. President and

Dicerna Pharmaceuticals, Inc. 87 Cambridgepark Drive
Cambridge, MA 02140

General Counsel
Dicerna Pharmaceuticals, Inc. 87 Cambridgepark Drive
Cambridge, MA 02140

b. To the Executive. All communications from the Company to the Executive relating to this Agreement shall be sent to the Executive in writing, at the most recent address on file with the Company.

With a copy to:

Robert Ciappenelli
40 Kings Way, Apt 304 B
Waltham, MA 02451

c. Time Notice Deemed Given. Notice shall be deemed to have been given when delivered or, if earlier (1) three business days after mailing by United States certified or registered mail, return receipt requested, postage prepaid, or (2) sent by overnight mail or delivery with confirmation of delivery, in either case, addressed as required in this section.

7. Amendment. No provisions of this Agreement may be modified, waived, or discharged except by a written document signed by a Company officer duly authorized by the Board and the Executive. A waiver of any conditions or provisions of this Agreement in a given instance shall not be deemed a waiver of such conditions or provisions at any other time in the future.

8. Choice of Law; Forum Selection. The validity, interpretation, construction, and performance of this Agreement shall be governed by the laws of the Commonwealth of Massachusetts without regard to its conflicts of laws principles. Any claims or legal actions by one party against the other regarding this Agreement shall be commenced and maintained exclusively in any state or federal court located in the Commonwealth of Massachusetts, and the parties hereby submit to the jurisdiction and venue of any such court.

9. Successors. This Agreement shall be binding upon, and shall inure to the benefit of, the Executive and his estate, but the Executive may not assign or pledge this Agreement or any rights arising under it. Without the Executive's consent, the Company may assign this Agreement to any affiliate or to a successor to substantially all the business and assets of the Company.

10. Taxes; Code Sections 409A and 280G.

a. The Company shall withhold taxes from payments it makes pursuant to this Agreement as it reasonably determines to be required by applicable law.

b. If the benefits set forth in Section 4.e. of this Agreement constitute "non-qualified deferred compensation" subject to Section 409A, then the following conditions apply to the payment of such benefits:

i. Any termination of the Executive's employment triggering payment of benefits under Section

4.e. must constitute a "separation from service" under Section 409A(a)(2)(A)(i) of the Code, and Treas.Reg. §1.409A-l(h) before distribution of such benefits can commence. To the extent that the termination of the Executive's employment does not constitute a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-l(h) (as the result of further services that are reasonably anticipated to be provided by the Executive to the Company at the time the Executive's employment terminates), any benefits payable under Section 4.e. that constitute non-qualified deferred compensation under Section 409A shall be delayed until after the date of a subsequent event constituting a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Re g. §1.409A-1(h). For purposes of clarification, this Section shall not cause any forfeiture of benefits on the Executive's part but shall only act as a delay until such time as a "separation from service" occurs.

ii. If the Executive is a "specified employee" (as that term is used in Section 409A and regulations and other guidance issued thereunder) on the date his separation from service becomes effective, any benefits payable under Section 4.e. that constitute non-qualified deferred compensation subject to Section 409A shall be delayed until the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the date of the Executive's death, but only to the extent necessary to avoid the adverse tax consequences and penalties under Section 409A. On the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the Executive' s death, the Company shall pay the Executive in a lump sum the aggregate value of the non-qualified deferred compensation that the Company otherwise would have paid the Executive prior to that date under Section 4.e.

iii. If any amount to be paid to the Executive pursuant to this Agreement is "deferred compensation" subject to Section 409A, then each such payment which is conditioned upon Executive's execution of a release and which is to be paid or provided during a designated period that begins in one taxable year and ends in a second taxable year, shall be paid or provided in the later of the two taxable years.

iv. It is intended that each installment of the payments and benefits provided under Section 4.e. shall be treated as a separate "payment" for purposes of Section 409A.

v. Neither the Company nor the Executive shall have the right to accelerate or defer the delivery of any such payments or benefits except to the extent specifically permitted or required by Section 409A.

c. Notwithstanding any other provision of this Agreement to the contrary, in the event of any ambiguity in the terms of this Agreement, such term(s) shall be interpreted and at all times administered in a manner that avoids the inclusion of compensation in income under Section 409A, or the payment of increased taxes, excise taxes or other penalties under Section 409A.

d. The parties intend this Agreement to be in compliance with Section 409A. Executive acknowledges and agrees that Company does not guarantee the tax treatment or tax consequences associated with any payment or benefit arising under this Agreement, including but not limited to consequences related to Section409A.

e. If any payment or benefit the Executive would receive under this Agreement, when combined with any other payment or benefit Executive receives pursuant to a Change of Control (whether under this Agreement or otherwise) (such payment or benefit, for purposes of this section, a "Payment") would: (i) constitute a "parachute payment" within the meaning of Section 280G of the Code; and (ii) but for this sentence, be subject to the excise tax imposed by Section 4999 of the Code (the "Excise Tax"), then such Payment shall be either: (A) the full amount of such Payment; or (B) such lesser amount as would result in no portion of the Payment being subject to the Excise Tax, whichever of the foregoing amounts, taking into account the applicable federal, state and local employments taxes, income taxes, and the Excise Tax, results in Executive's receipt, on an after-tax basis, of the greater amount of the Payment notwithstanding that all or some portion of the Payment may be subject to the Excise Tax. The Payments will be reduced in the following order: (A) reduction of any cash severance payments otherwise payable to the Executive that are exempt from Section 409A of the Code; (B) reduction of any other cash payments or benefits otherwise payable to the Executive that are exempt from Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code; (C) reduction of any other payments or benefits otherwise payable to the Executive on a pro-rata basis or such other manner that complies with Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting and payments with respect to any equity awards that are exempt from Section 409A of the Code; and (D) reduction of any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code, in each case beginning with payments that would otherwise be made last in time.

11. Validity. The invalidity or unenforceability of any provision of this Agreement shall not affect the validity or enforceability of any other provision of this Agreement, which shall remain in full force and effect.

12. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original but all of which together shall constitute the same instrument.

13. Entire Agreement; Prior Agreements. This Agreement constitutes the entire agreement among the parties with respect to the subject matter hereof and, unless otherwise provided herein, supersedes all prior agreements, negotiations or understandings, written or oral, in respect thereof.

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DICERNA PHARMACEUTICALS, INC.

Date: June 17, 2019 /s/ Douglas M. Fambrough III, PhD.

Douglas M. Fambrough III, Ph.D.
Its: President and CEO

Date: June 19, 2019 /s/ Robert Ciappenelli

Robert Ciappenelli

By: Robert Ciappenelli

Exhibit 10.55

EMPLOYMENT AGREEMENT (Revised)

EMPLOYMENT AGREEMENT ("Agreement") made this February 21, 2020 (the "Effective Date") between Dicerna Pharmaceuticals, Inc., a Delaware corporation ("Company"), on the one hand and Robert Ciappenelli (the "Executive") on the other hand.

WHEREAS, the Company desires to employ the Executive and the Executive desires to be employed by the Company, on terms set forth herein;

NOW, THEREFORE, in consideration of the mutual agreements set forth herein, the parties agree as follows:

1. Term of Employment. The Executive's employment under this Agreement shall commence on the Effective Date and shall end on such date as the Executive's employment terminates in accordance with Section 4 of this Agreement. Subject to the balance of this Agreement, the Executive shall be an at-will employee of the Company whose employment may be terminated (by the Company or by the Executive) at any time, for any or no reason, in which case the Executive will be entitled to the separation benefits set forth in Section 4, below.

2. Duties. During his employment with the Company, the Executive shall have the title of Chief Commercial Officer. The Executive shall devote his full business time and effort to the performance of his duties for the Company, which he shall perform faithfully and to the best of his ability. The Executive shall have all of the customary powers and duties associated with his position and shall be subject to the Company's policies, procedures, and approval practices, as generally in effect from time to time for all senior executives of the Company and the direction and oversight of the Board. The Executive will report directly to the Chief Executive Officer of the Company.

3. Compensation and Related Matters.

a. Base Salary. The Company shall pay the Executive base salary at a rate of $15,941paid twice monthly (which annualizes to $382,583), less withholdings and deductions required and/or permitted by law. The Executive's base salary shall be paid in conformity with the Company's payroll practices generally applicable to the Company's senior executives.

b. Annual Bonus.

The Executive shall be eligible to be considered for an Annual Bonus upon achieving of certain pre-determined performance targets consistent with any Incentive Compensation Plan established by the Compensation Committee (the "Committee"). The Annual Bonus shall be based, in part, on the Executive's performance. The grant of such a bonus shall be in the sole discretion of the Committee. The maximum bonus amount for which the Executive will be eligible is forty percent (40%)of base salary earned for the calendar year, provided that, the Annual Bonus for the first year of employment shall be prorated based on the date of hire. The Annual Bonus will be earned only after it has been granted by the Committee. The Annual Bonus shall be paid to the Executive following the close of the fiscal year to which it relates, in no event later than March 15th of the calendar year immediately following the calendar year in which it was earned. The Executive must be actively employed by the Company at the time the Committee considers granting of bonuses to be eligible to receive such bonus.

c. Equity Compensation. Subject to approval of the Board or an appropriate committee thereof, Executive shall be eligible for equity compensation awards, in such amounts and subject to such terms as shall be commensurate with awards granted to other senior executives of the Company.

d. Benefits. During his employment with the Company, the Executive shall be entitled to participate in all employee benefit plans and programs, including paid sick leave and holidays, life insurance, disability, medical, dental, and retirement savings plans, to the same extent generally available to senior executives of the Company, in accordance with the terms of those plans and programs. The Executive shall be permitted up to four weeks of paid vacation per year, which will accrue on a monthly basis. The Executive will not be allowed to accumulate more than three weeks of unused vacation days at any given time. The Executive may carry over a maximum of ten unused vacation days from one calendar year to the next.

e. Expenses. The Company agrees to reimburse the Executive for reasonable out-of-pocket expenses incurred in connection with Company business and within standards to be established by the Board from time to time, including, without limitation, travel and accommodations for authorized business trips, provided vouchers therefor, or other supporting information as the Company may reasonably require, are presented to the Company. All reimbursements provided under this Agreement shall be made or provided in accordance with the requirements of Section 409A of the Internal Revenue Code of 1986, as amended (the "Code") and the rules and regulations thereunder ("Section 409A") including, where applicable, the requirement that (i) any reimbursement is for expenses incurred during the Executive's lifetime (or during a shorter period of time specified in this Agreement); (ii) the amount of expenses eligible for reimbursement during a calendar year may not affect the expenses eligible for reimbursement in any other calendar year; (iii) the reimbursement of an eligible expense shall be made no later than the last day of the calendar year following the year in which the expense is incurred; and (iv) the right to reimbursement or in kind benefits is not subject to liquidation or exchange for another benefit.

4. Termination

a. Rights and Duties. The Executive is an employee "at will." Accordingly, the Company or the Executive may terminate his employment, at any time with or without cause, for any lawful reason, or no reason. The Executive and the Company agree that, without modifying or altering the Executive's "at will" status, each will provide the other with at least thirty (30) days' prior written notice of termination of the Executive's employment with the Company. If the Executive gives notice of termination, except in the case of a termination by the Executive for "Good Reason" as set forth below, such notice will be deemed a voluntary resignation by the Executive and the Company, in its sole discretion, may elect to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, without changing the status of such termination as a voluntary resignation by the Executive. Should the Company in the event of a voluntary resignation decide to relieve the Executive of any obligation to perform duties during the notice period, waive the notice period and immediately accept termination of the Executive's employment, it shall nonetheless continue his compensation and benefits for the term of the notice period, except that no bonus shall be earned or awarded during and after the notice period.

b. Termination for "Good Reason." The Executive may terminate his employment at any time for "Good Reason." "Good Reason" shall comport with the requirements of Regulation §1.409A-l(n)(2)(ii) and shall mean:

i. A material diminution in the Executive's authority, duties, responsibilities or reporting responsibilities;

ii. A material diminution by the Company of the Executive's annual base compensation then in effect, except a material diminution generally affecting the members of the Company's management;

iii. Any action or inaction by the Company that constitutes a material breach by the Company of the terms of this Agreement; or

iv. A requirement that the Executive be based more than 50 miles from the offices at which he was principally employed immediately prior to the date of termination.

The parties acknowledge and agree that "Good Reason" shall not be deemed to have occurred unless: (1) the Executive provides the Company with written notice that he intends to terminate his employment hereunder for one of the Good Reason grounds set forth in Section 4.b. within sixty (60) days of the initial occurrence of such ground, with such notice containing a description of such ground, (2) if such Good Reason ground is capable of being cured, the Company has failed to cure such ground within a period of thirty (30) days from the date of such written notice, and (3) the Executive terminates his employment within ninety-one (91) days from the date that such Good Reason ground first occurs. For purposes of clarification, the above-listed conditions shall apply separately to each occurrence of a Good Reason ground, and failure to adhere to such conditions in the event of the occurrence of grounds that would otherwise have constituted Good Reason had the conditions herein been satisfied shall not disqualify the Executive from asserting and satisfying the conditions for Good Reason for any subsequent occurrence that may constitute Good Reason.

c. Termination by the Company for Cause. The Company may terminate the Executive's employment at any time for "Cause." "Cause" shall mean:

i. The Executive's commission of an act of fraud, dishonesty, breach of fiduciary duty or misappropriation which may or does adversely affect the Company;

ii. The Executive's conviction or plea of guilty or *nolo contendere* to or engaging in any felony or crime involving moral turpitude, fraud, misrepresentation or other crime and/or indictment for a crime that, in the reasonable opinion of the Company, affects the Executive's ability to perform the duties set forth in this Agreement and/or reflects negatively upon the Company;

iii. Unauthorized disclosure by the Executive of the Company's Proprietary Information, as defined in the Nondisclosure Agreement (as defined in Section 5 below), which results or could have been reasonably foreseen to result, in a material financial loss to the Company;

iv. The Executive's material breach of this Agreement or the Nondisclosure Agreement; provided, that if such breach is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such breach to cure; or

v. The Executive's failure (which shall not include any Disability as defined below) or refusal to perform the duties and responsibilities of his employment and/or to follow the policies and procedures of the Company, including without limitation the failure or refusal to carry out lawful instructions from the Board. If such failure or refusal is reasonably possible of being cured in the opinion of the Company, then the Executive will be given thirty (30) days after written notice from the Company of such failure or refusal to cure.

d. Termination in the Event of Death or Disability. The Agreement shall terminate upon the Executive's death or Disability, and the Executive's employment with the Company shall thereupon terminate. For purposes of the Agreement, "Disability" is defined as any illness, injury, accident or condition of either a physical or psychological nature as a result of which the Executive is unable to perform the essential functions of his duties and responsibilities hereunder for 90 days during any period of 365 consecutive calendar days or for any consecutive 90-day period.

e. Effect of Termination.

i. If the Executive is terminated by the Company for Cause, or by the Executive voluntarily other than for Good Reason, then the Executive will only be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued but unused prior to termination of employment.

ii. If the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) Continuation of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination for a twelve (12) month period, payable in accordance with the Company's regular payroll practices, less applicable withholdings, commencing at the conclusion of the Review Period (as described below), *provided* that the first installment of such payments shall include all amounts which would have been paid during the period between the Executive's date of termination and the date of such first installment;

b) Payment of a pro-rata portion of the actual amount of the Executive's Annual Bonus based on actual performance determined under the terms of the Company's annual bonus program as then in effect, with such pro-rata portion calculated by multiplying the actual amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made after the determination of the bonus funding level (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs); and

c) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) twelve (12) months or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for

premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA.

iii. If the Agreement is terminated because of the Executive's death, the Company shall pay to the estate of the Executive the salary and benefits which would otherwise have been payable to the Executive up to the date of termination of his employment because of death.

iv. In the event of a Change of Control (as defined below) occurs and, if within one (1) year thereafter, the Executive's employment is terminated by the Company other than for Cause, or by the Company due to the Executive's Disability, or by the Executive for Good Reason (each of which will be deemed an involuntary termination), then the Executive will be entitled to payment when due of any unpaid base salary, expense reimbursements, and vacation days accrued prior to termination of employment and, in exchange for the Executive's execution of a separation agreement and general release provided by the Company (including, at the Company's option, a non-competition obligation during any salary continuation period and (at the Company's option) a revocation period of seven (7) business days) and expressly subject to the conditions described in Section 4.e.vi. below, the following:

a) A lump sum payment equal to the sum of (i) one (1) year of the Executive's base salary at the rate in effect as of the day immediately preceding his date of termination, less applicable withholdings, plus (ii) the Executive's target annual bonus for the year in which the termination occurs, less applicable withholdings, payable at the conclusion of the Review Period (as described below);

b) The Executive shall be eligible to continue health benefits pursuant to COBRA or the appropriate state equivalent. If the Executive is eligible for and properly elects continuation of such coverage during the permissible time frame, the Company will pay the premiums for such group health insurance coverage for the shorter of (i) one (1) year or (ii) until the Executive becomes eligible for health benefits through another employer or otherwise. After the shorter period, the Executive will be responsible for premium payments for continuation of such group health insurance coverage pursuant to the terms and conditions of COBRA; and

c) Payment of a pro-rata portion of the target amount of the Executive's annual bonus, with such pro-rata portion calculated by multiplying the target amount of such bonus for the year in which such termination occurs by a number: (x) the numerator of which is the number of days worked by the Executive during the fiscal year prior to termination, and (y) the denominator of which is three hundred sixty five (365), with such payment to be made at the conclusion of the Review Period (but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs).

v. In addition, in the event of a Change of Control, notwithstanding anything to the contrary in any applicable option agreement or stock-based award agreement, all time-based stock options and other time-based stock-based awards held by the Executive, to the extent unvested as of immediately prior to the Change of Control shall immediately accelerate and become fully exercisable or nonforfeitable immediately prior to the consummation of the Change of Control.

For purposes of this Agreement, "Change of Control" means (A) the occurrence of a merger or consolidation of the Company whether or not approved by the Board, other than (i) a merger or consolidation which would result in the voting securities of the Company outstanding immediately prior thereto continuing to represent (either by remaining outstanding or by being converted into voting securities of the surviving entity or the parent of such corporation) at least 50% of the total voting power represented by the voting securities of the Company or such surviving entity or parent of such corporation outstanding immediately after such merger or consolidation, or (ii) a merger or consolidation which is in effect a financing transaction for the Company, including, but not limited to, a reverse merger of the Company into a publicly traded "shell" company, or (B) the stockholders of the Company approve an agreement for the sale or disposition by the Company of all or substantially all of the Company's assets, provided that, in any case, "Change of Control" shall be in accordance with Regulation §1.409A-3(i)(5).

vi. Payment of the severance pay and benefits described in Section 4.e.ii. or 4.e.iv., as applicable, is expressly conditioned on the Executive's execution without revocation of the separation agreement and general release described therein, within the time period prescribed in the separation agreement and general release (which release shall include, at the Company's option, a non-competition obligation during any salary

continuation period and (at the Company's option) a revocation period of seven (7) business days), and will commence immediately following a sixty (60) day period following the effective date of the Executive's separation from service from the Company (the "Review Period") (with the exception of the pro rata annual bonus payment described in Section 4.e.ii.b., which shall be payable after the bonus funding level is determined but in no event later than March 15 of the calendar year following the year in which the Executive's termination occurs). The separation agreement and general release will be provided to the Executive on or before the fifth (5th) day following such separation from service. If the Executive fails or refuses to return such agreement within the Review Period, the applicable severance payments and benefits will be forfeited. If the Executive is eligible for the severance pay and benefits described in Section 4.e.ii., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.iv. Similarly, if the Executive is eligible for the severance pay and benefits described in Section 4.e.iv., then he shall not be eligible for and shall not receive the severance pay and benefits described in Section 4.e.ii.

5. Nondisclosure, Non-Solicitation and Assignment Agreement. As a condition of the Executive's employment by the Company and the payment of compensation and receipt of benefits referred to above, the Executive agrees to continue to be bound by the terms of the standard **Nondisclosure, Non-Solicitation and Assignment Agreement**, entered into by the Executive as of 5/23/2019 (the "Nondisclosure Agreement"). The Executive acknowledges that the Company would not offer him employment or provide compensation and/or benefits set forth above if he was not willing to be bound by the terms of such Nondisclosure Agreement.

6. Notice.

a. To the Company. The Executive will send all communications to the Company in writing, addressed as follows (or in any other manner the Company notifies him to use):

Douglas M. Fambrough III, Ph.D. President and CEO
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

With a copy to:

General Counsel
Dicerna Pharmaceuticals, Inc.
33 Hayden Ave
Lexington, MA 02140

b. To the Executive. All communications from the Company to the Executive relating to this Agreement shall be sent to the Executive in writing, at the most recent address on file with the Company.

With a copy to:

Robert Ciappenelli
35 Kings Way Unit 3
Waltham, MA 02451

c. Time Notice Deemed Given. Notice shall be deemed to have been given when delivered or, if earlier (1) three business days after mailing by United States certified or registered mail, return receipt requested, postage prepaid, or
(2) sent by overnight mail or delivery with confirmation of delivery, in either case, addressed as required in this section.

7. Amendment. No provisions of this Agreement may be modified, waived, or discharged except by a written document signed by a Company officer duly authorized by the Board and the Executive. A waiver of any conditions or provisions of this Agreement in a given instance shall not be deemed a waiver of such conditions or provisions at any other time in the future.

8. Choice of Law; Forum Selection. The validity, interpretation, construction, and performance of this Agreement shall be governed by the laws of the Commonwealth of Massachusetts without regard to its conflicts of laws principles. Any claims or legal actions by one party against the other regarding this Agreement shall be commenced and maintained exclusively in any state or federal court located in the Commonwealth of Massachusetts, and the parties hereby submit to the jurisdiction and venue of any such court.

9. Successors. This Agreement shall be binding upon, and shall inure to the benefit of, the Executive and his estate, but the Executive may not assign or pledge this Agreement or any rights arising under it. Without the Executive's consent, the Company may assign this Agreement to any affiliate or to a successor to substantially all the business and assets of the Company.

10. Taxes; Code Sections 409A and 280G.

a. The Company shall withhold taxes from payments it makes pursuant to this Agreement as it reasonably determines to be required by applicable law.

b. If the benefits set forth in Section 4.e. of this Agreement constitute "non-qualified deferred compensation" subject to Section 409A, then the following conditions apply to the payment of such benefits:

i. Any termination of the Executive's employment triggering payment of benefits under Section 4.e. must constitute a "separation from service" under Section 409A(a)(2)(A)(i) of the Code, and Treas. Reg. §1.409A-1(h) before distribution of such benefits can commence. To the extent that the termination of the Executive's employment does not constitute a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h) (as the result of further services that are reasonably anticipated to be provided by the Executive to the Company at the time the Executive's employment terminates), any benefits payable under Section 4.e. that constitute non-qualified deferred compensation under Section 409A shall be delayed until after the date of a subsequent event constituting a separation of service under Section 409A(a)(2)(A)(i) of the Code and Treas. Reg. §1.409A-1(h). For purposes of clarification, this Section shall not cause any forfeiture of benefits on the Executive's part, but shall only act as a delay until such time as a "separation from service" occurs.

ii. If the Executive is a "specified employee" (as that term is used in Section 409A and regulations and other guidance issued thereunder) on the date his separation from service becomes effective, any benefits payable under Section 4.e. that constitute non-qualified deferred compensation subject to Section 409A shall be delayed until the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the date of the Executive's death, but only to the extent necessary to avoid the adverse tax consequences and penalties under Section 409A. On the earlier of: (A) the business day following the six-month anniversary of the date his separation from service becomes effective, or (B) the Executive's death, the Company shall pay the Executive in a lump sum the aggregate value of the non-qualified deferred compensation that the Company otherwise would have paid the Executive prior to that date under Section 4.e.

iii. If any amount to be paid to the Executive pursuant to this Agreement is "deferred compensation" subject to Section 409A, then each such payment which is conditioned upon Executive's execution of a release and which is to be paid or provided during a designated period that begins in one taxable year and ends in a second taxable year, shall be paid or provided in the later of the two taxable years.

iv. It is intended that each installment of the payments and benefits provided under Section 4.e. shall be treated as a separate "payment" for purposes of Section 409A.

v. Neither the Company nor the Executive shall have the right to accelerate or defer the delivery of any such payments or benefits except to the extent specifically permitted or required by Section 409A.

c. Notwithstanding any other provision of this Agreement to the contrary, in the event of any ambiguity in the terms of this Agreement, such term(s) shall be interpreted and at all times administered in a manner that avoids the inclusion of compensation in income under Section 409A, or the payment of increased taxes, excise taxes or other penalties under Section 409A.

d. The parties intend this Agreement to be in compliance with Section 409A. Executive acknowledges and agrees that Company does not guarantee the tax treatment or tax consequences associated with any payment or benefit arising under this Agreement, including but not limited to consequences related to Section 409A.

e. If any payment or benefit the Executive would receive under this Agreement, when combined with any other payment or benefit Executive receives pursuant to a Change of Control (whether under this Agreement or otherwise) (such payment or benefit, for purposes of this section, a "Payment") would: (i) constitute a "parachute payment" within the meaning of Section 280G of the Code; and (ii) but for this sentence, be subject to the excise tax imposed by Section 4999 of the Code (the "Excise Tax"), then such Payment shall be either: (A) the full amount of such Payment; or (B) such lesser amount as would result in no portion of the Payment being subject to the Excise Tax, whichever of the foregoing amounts, taking into account the applicable federal, state and local employments taxes, income taxes, and the Excise Tax, results in Executive's receipt, on an after-tax basis, of the greater amount of the Payment notwithstanding that all or some portion of the Payment may be subject to the Excise Tax. The Payments will be reduced in the following order: (A) reduction of any cash severance payments otherwise payable to the Executive that are exempt from Section 409A of the Code; (B) reduction of any other cash payments or benefits otherwise payable to the Executive that are exempt from Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code; (C) reduction of any other payments or benefits otherwise payable to the Executive on a pro-rata basis or such other manner that complies with Section 409A of the Code, but excluding any payments attributable to any acceleration of vesting and payments with respect to any equity awards that are exempt from Section 409A of the Code; and (D) reduction of any payments attributable to any acceleration of vesting or payments with respect to any equity awards that are exempt from Section 409A of the Code, in each case beginning with payments that would otherwise be made last in time.

11. Validity. The invalidity or unenforceability of any provision of this Agreement shall not affect the validity or enforceability of any other provision of this Agreement, which shall remain in full force and effect.

12. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original but all of which together shall constitute the same instrument.

13. Entire Agreement; Prior Agreements. This Agreement constitutes the entire agreement among the parties with respect to the subject matter hereof and, unless otherwise provided herein, supersedes all prior agreements, negotiations or understandings, written or oral, in respect thereof.

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DICERNA PHARMACEUTICALS, INC.

Date: 2/21/2020

/s/ Douglas M. Fambrough III, PhD.

By: Douglas Fambrough

III, Ph.D.
Its: President and CEO

Date: 2/21/2020

/s/ Robert Ciappenelli

Robert Ciappenelli
Chief Commercial Officer

Exhibit 10.56

February 26, 2020

John B. Green
91 Elliott Drive
Lowell, MA 01852

Re: Transition Agreement

Dear Jack:

Dicerna Pharmaceuticals, Inc. (the "Company") greatly appreciates your dedication and service to the Company. You and I have discussed our mutual interest in bringing your employment to an end and doing so in a manner that provides a smooth transition for both you and the Company. This letter agreement (the "Agreement") confirms terms that we have discussed concerning your continued employment for a limited period, the termination of your employment, severance pay and benefits and consulting terms. Under this Agreement, you will have the opportunity to receive the same post-employment severance pay and benefits that are available under your February 21, 2020 Employment Agreement (Revised) with the Company (the "Employment Agreement") plus certain bonus and equity enhancements in exchange for your performance of consulting services through June 30, 2021.

This Agreement amends the Employment Agreement and the Amended and Restated Indemnification Agreement dated April 11, 2017 between you and the Company (the "Indemnification Agreement"). It also amends certain Equity Documents, as defined below.

Specifically, you and the Company agree as follows:

1. Transition Period

(a) Hire of New CFO and Termination of Employment. The Company is currently engaged in a search for a new Chief Financial Officer (the "New CFO"). The Company anticipates continuing your employment as Chief Financial Officer through the date of the commencement of employment of the New CFO (the "New CFO Hire Date") and possibly for a limited period beyond the New CFO Hire Date. To the extent that your employment continues beyond the New CFO Hire Date, you shall be transitioned to a senior advisor role with a title and responsibilities as determined by the Company. Consistent with the Employment Agreement, the Company reserves the right to terminate your employment at any time and shall not be required to provide the thirty (30) days' written notice pursuant to Section 4(a) of the Employment Agreement. The period of your employment from the Effective Date (as defined below) to the date of termination of your employment, which in no event will be later than June 30, 2021, is

referred to in this Agreement as the "Transition Period." The date of termination of your employment is referred to as the "Termination Date."

(b) Responsibilities. During the Transition Period, you shall use your reasonable best efforts to perform the responsibilities that are assigned to you. For such period that you remain Chief Financial Officer, you shall perform the responsibilities of that function, consistent with Section 2 of the Employment Agreement; *provided* that notwithstanding anything to the contrary in Section 2 of the Employment Agreement, your title, authority and responsibilities may be modified by the Company's President and CEO at any time during the remaining period of your employment with the Company. You hereby waive any and all rights to terminate your employment for "Good Reason" based upon a material diminution in your authority, duties, responsibilities or title pursuant to Section 4(b)(i) of the Employment Agreement. You acknowledge that your responsibilities during the remaining period of your employment may include assisting in the recruitment, interview and hire of the New CFO.

(c) Compensation. During the Transition Period, your at-will employment shall continue on a full-time basis, you will be paid at the rate of your current base salary, which is $415,800 per year (the "Base Salary"), and your compensation terms with respect to benefits and expenses pursuant to Sections 3(d) and 3(e) of the Employment Agreement shall continue in effect.

(d) Acknowledgment. You acknowledge that as of the Company's most recent payroll payment of salary to you, you were fully paid for all salary then due to you. You acknowledge that as of the date of this letter, your accrued but unused vacation time totaled two (2) days (in the amount of $2,987.24). You shall continue to accrue and be eligible to use paid vacation time in accordance with the Company's policies during the Transition Period.

2.Severance Benefits

Provided that (i) you fully comply at all times with your obligations pursuant to this Agreement and the Nondisclosure, Noncompetition and Assignment Agreement dated January 1, 2015 and signed on January 14, 2016 (the "Confidentiality Agreement"), including the post-employment non-competition and non-solicitation obligations you entered into with the Company; (ii) you remain employed with the Company until the Termination Date that is hereafter designated by the Company unless you terminate your employment for "Good Reason" under Section 4(b)(ii), (iii) or (iv) of the Employment Agreement; and (iii) there is no "Cause" for termination of your employment as defined in Section 4(c) of the Employment Agreement (together, the "Conditions"), you will be eligible for the following "Severance Benefits."

(a) Severance Pay. The Company shall pay you severance pay ("Severance Pay") consisting of salary continuation at your Base Salary rate, less applicable tax-related deductions and withholdings, effective for the 12-month period immediately following the Termination Date (the "Severance Pay Period"). Severance Pay shall be payable in accordance with the Company's regular payroll practices. Notwithstanding anything to the contrary in the foregoing or in the

Employment Agreement, the Company shall not be obligated to continue the payment of the Severance Pay if you do not sign the Release Agreement attached to this Agreement as Exhibit A within the twenty-one (21) day time period set forth in the Release Agreement or if you revoke the Release Agreement after signing it. The Release Agreement shall be deemed to be tendered to you upon the Termination Date; *provided* that the Company may substitute a substantially identical Release Agreement in place of Exhibit A and tender such Release Agreement on or promptly after the Termination Date. You are not authorized to sign the Release Agreement before the Termination Date.

(b) Bonus. Notwithstanding anything to the contrary in your Employment Agreement or otherwise, the Company shall pay you a bonus payment based on the Company's calendar year 2020 corporate goal achievements (the "Annual Bonus"); *provided*, subject to your continued satisfaction of the Conditions. For calendar year 2020, the target Annual Bonus shall be forty percent (40%) of the Base Salary, and the actual amount shall be determined in the sole discretion of the Company's Board of Directors (the "Board") based on the full calendar year 2020 as if you had been an employee of the Company for the entire year and based on the achievement of corporate objectives, as determined by the Board. The Annual Bonus shall be paid to you at the same time bonus payments are made to senior executives, but in no event later than March 15, 2021. You acknowledge and agree that your opportunity to receive the Annual Bonus set forth in this Section 2(b) is in lieu of any bonus or incentive compensation payments otherwise due to you pursuant to the Employment Agreement or otherwise.

(c) Health Benefits. If you elect continuation of group medical, dental and vision insurance coverage pursuant to the law known as "COBRA," the Company shall pay the premiums for such group medical, dental and vision coverage as in effect for you on the Termination Date until the earliest of the following: (i) the end of the Consulting Period (as defined below) or the end of the Severance Pay Period, whichever occurs later; (ii) your eligibility for group medical care coverage through other employment; or (iii) the end of your eligibility under COBRA for continuation coverage for medical, dental and vision care (the Company's payment of such premiums, the "Health Benefits"). Notwithstanding anything to the contrary in the foregoing or the Employment Agreement, the Company shall not be obligated to continue the Health Benefits if you do not sign the Release Agreement within the twenty-one (21) day time period set forth in the Release Agreement or if you revoke the Release Agreement after signing it. You agree to notify the Company promptly if you become eligible for group medical care coverage through another employer. You also agree to respond promptly and fully to any reasonable requests for information by the Company concerning your eligibility for such coverage. After the conclusion of the Company's payment of Health Benefits, you may continue coverage at your own expense for the remainder of the COBRA continuation period, subject to continued eligibility.

For the avoidance of doubt, you acknowledge and agree that the Severance Benefits provided for in this Section 2 and the bonus pursuant to Section 4(b) below satisfy and replace the Company's severance pay and benefits obligations pursuant to Section 4(e) of the Employment Agreement.

3.Consulting Period

Subject to the Conditions, the Company shall retain you as an independent contractor to provide consulting services as reasonably requested by the Company during the period from the Termination Date to June 30, 2021, or an earlier or later date consistent with the terms of this Agreement (the "Consulting Period"), *provided*, however, that the Consulting Period shall continue only if you also sign the Release Agreement within the time period set forth in the Release Agreement and do not revoke the Release Agreement. Such consulting services may consist of any transitional assistance, any responsibilities of a Chief Financial Officer or any other responsibilities that the Company may reasonably request ("Consulting Services"). For the avoidance of any doubt, your transition from employment status during the Transition Period to independent contractor status during the Consulting Period shall constitute a "separation from service" for purposes of Section 409A(a)(2)(A)(i) of the Internal Revenue Code of 1986, as amended (the "Code"), and Treas. Reg. § 1.409A-1(h). The parties confirm that they expect that at least for an initial period following the Termination Date, the Consulting Services are not expected to exceed forty (40) hours in any 30-day period; *provided* that this statement of the parties' expectations does not limit the Company's right to increase the expectation to perform Consulting Services beyond such level, subject to the terms of Section 3(d) below.

(a) Services. During the Consulting Period, you shall perform Consulting Services at reasonable times requested by the Company; *provided that* the Company shall not require you to provide any services at any times that would materially interfere with your other commitments, unless Section 5(c) below is applicable.

(b) Equity. For the avoidance of doubt, your performance of and availability to perform Consulting Services during the Consulting Period constitute a continued service relationship with the Company for purposes of the Equity Documents, as defined below. As a result, your unvested equity as of the Termination Date shall continue to vest until the end of the Consulting Period. At the conclusion of the Consulting Period, you shall be eligible to exercise all vested equity awards pursuant to the terms of the Equity Documents (i.e., three (3) months from the end of the Consulting Period, but no later than the expiration date of the award). The "Equity Documents" mean all options that you hold to purchase shares of the Company's common stock pursuant to the Company's Notice of Grant of Stock Option dated April 14, 2016, the Company's Annual Stock Option Grant Notice dated January 3, 2017, the Company's Stock Option Grant Notice dated January 4, 2018, the Company's Stock Option Grant Notice dated January 2, 2019, the Company's Notice of Grant of Stock Option dated January 8, 2020, the associated Terms and Conditions of each such grant, as may be amended from time to time, the Company's Amended and Restated 2014 Performance Incentive Plan, as amended and restated on May 7, 2019, and as may be further amended from time to time and the restricted stock award that you were granted pursuant to the

Restricted Stock Unit Grant Notice dated January 8, 2020 and the related Restricted Stock Unit Award Agreement.

(c) Equity Acceleration. As further consideration for your performance of and availability to perform Consulting Services during the Consulting Period, and notwithstanding anything to the contrary in the Equity Documents, you shall have the opportunity to fully vest in all time-based stock options and other time-based stock-based awards held by you (the "Time-Based Equity Awards") if certain events occur during the Consulting Period; *provided* that you continue to satisfy all of the Conditions. More specifically, if during the Consulting Period, the Company executes a letter of intent or an equivalent agreement with a potential acquirer contemplating a Change of Control (as defined in the Employment Agreement) (such letter or agreement, an "LOI"), then upon the consummation of the Change of Control, all Time-Based Equity Awards held by you to the extent unvested as of immediately prior to the Change of Control shall immediately accelerate and become fully exercisable or nonforfeitable upon the consummation of the Change of Control. To effectuate this provision, any termination or forfeiture of the unvested portion of the Time-Based Equity Awards that would otherwise occur at the conclusion of the Consulting Period in the absence of this Agreement will be delayed unless and until the effective date of the consummation of the Change of Control, subject to the timely execution of an LOI. For the avoidance of doubt, notwithstanding anything to the contrary in the foregoing, in no event will the Time-Based Equity Awards vest or become exercisable after their respective expiration dates provided in the applicable Equity Documents.

(d) Increased Services; Extension. In the event that the Company requests that you provide Consulting Services for more than forty (40) hours in any 30-day period during the Consulting Period, the Consulting Period shall automatically extend in 30-day increments, subject to the Company's continued request that you provide Consulting Services for more than forty (40) hours in any 30-day period. In the event the Consulting Period is automatically extended, the Company will confer with you and consider providing you with additional compensation in recognition of your performance of such increased Consulting Services. For the avoidance of doubt, such increase in Consulting Services may be due, without limitation, to a need as determined by the Company for you to resume the performance of services as the Company's Chief Financial Officer.

(e) Independent Contractor Status. During the Consulting Period, you shall act solely as an independent contractor and this Agreement shall not be construed to create any employee/employer relationship between you and the Company. You shall accept any directions issued by the Company pertaining to the goals to be attained and the results to be achieved by you in providing Consulting Services, but you shall be solely responsible for the manner in which you perform such Consulting Services. You shall not be eligible to participate in any employee benefit plans or programs, including without limitation life insurance, disability, medical, dental, vision and retirement savings plans during the Consulting Period. You shall also

not be eligible for workers' compensation coverage or participation as an employee in the Social Security or unemployment compensation programs with respect to your performance of Consulting Services during the Consulting Period.

(f) Your Termination Right. Notwithstanding anything in the foregoing to the contrary, you shall have the right to terminate the Consulting Period upon thirty (30) days' prior written notice to the Company.

4.Tax Treatment

The Company shall make deductions, withholdings and tax reports with respect to payments and benefits under this Agreement that it reasonably determines to be required. Payments under this Agreement shall be in amounts net of any such deductions or withholdings. Nothing in this Agreement shall be construed to require the Company to make any payments to compensate you for any adverse tax effect associated with any payments or benefits or for any deduction or withholding from any payment or benefit.

5.Communications

The Company shall consult with you regarding the text for material public disclosure concerning your anticipated termination of employment. You shall reasonably cooperate with the Company with respect to any such disclosure or other general communication regarding your termination and transition to service as a consultant.

6.Continuing Obligations

You acknowledge that your obligations under the Confidentiality Agreement shall continue in effect, including without limitation your obligations to maintain the confidentiality of Confidential Information as defined in the Confidentiality Agreement, to return documents and other property of the Company, to cooperate with the Company with respect to the procurement, maintenance and enforcement of intellectual property rights, and to refrain from certain competitive and solicitation activities for a period of two (2) years following the end of your employment. A copy of the Confidentiality Agreement is enclosed as Exhibit B. You acknowledge and agree that the terms and obligations of the Confidentiality Agreement are hereby incorporated by reference as material terms of this Agreement. You further agree that notwithstanding anything to the contrary in the Confidentiality Agreement, your obligation not to disclose Confidential Information, as defined in Section 5 of the Confidentiality Agreement, shall apply to Confidential Information that is disclosed to you during the Consulting Period. In addition, you agree that notwithstanding anything to the contrary in the Confidentiality Agreement, your disclosure and assignment obligations provided in Section 7 of the Confidentiality Agreement shall apply to Developments, as defined in Section 7(a) of the Confidentiality Agreement, during the Consulting Period.

7.Return of Property

You shall not dispose of the Company property (including information or documents, including computerized data and any copies made of any computerized data or software ("Documents")), without authorization. Upon the end of the Consulting Period and earlier if so requested by the

Company, you shall return to the Company all Company property including, without limitation, computer equipment, software, keys and access cards, credit cards, files and any Documents containing information concerning the Company, its business or its business relationships (in the latter two cases, actual or prospective). After returning all Company property, you commit to deleting and finally purging any duplicates of files or documents that may contain Company information from any non-Company computer or other device that remains your property after the date of your obligation to return Company property.

8.Non-Disparagement

You agree not to make or endorse any disparaging, derogatory, adverse, and/or otherwise negative remarks and/or statements (whether oral, written, or otherwise) concerning the Company or its current or former officers, directors, partners, shareholders, investors, business partners or employees; *provided* that if any current or former officer, director, partner, shareholder, investor, business partner or employee makes any disparaging, derogatory, adverse, and/or otherwise negative remarks and/or statements (whether oral, written, or otherwise) concerning you, you shall no longer be subject to this Section 8 with respect to remarks and/or statements about such current or former officer, director, partner, shareholder, investor, business partner or employee; and *provided* further that statements shall not be considered to be subject to this Section 8 if they are made reasonably and in good faith in connection with the performance of responsibilities for the Company. These non-disparagement obligations shall not in any way affect your obligation to provide truthful information consistent with the law or legal process.

9.Future Cooperation

During the Transition Period, the Consulting Period and thereafter, you agree to cooperate reasonably with the Company (including its outside counsel) in connection with (i) the contemplation, prosecution and defense of all phases of existing, past and future litigation about which the Company believes you may have knowledge or information; and (ii) responding to requests for information from regulatory agencies or other governmental authorities (together. the "Cooperation Services"). You further agree to make yourself available to provide Cooperation Services at mutually convenient times during and outside of regular business hours as reasonably deemed necessary by the Company's counsel. The Company shall not utilize this section to require you to make yourself available to an extent that would materially interfere with other commitments that you may have. Cooperation Services include, without limitation, appearing without the necessity of a subpoena to testify truthfully in any legal proceedings in which the Company calls you as a witness. The Company shall reimburse you for any reasonable travel expenses that you incur due to your performance of Cooperation Services, after receipt of appropriate documentation consistent with the Company's business expense reimbursement policy.

10.Protected Disclosures; Defend Trade Secrets Act of 2016

Nothing in this Agreement shall be interpreted or applied to prohibit you from making any good faith report to any governmental agency or other governmental entity (a "Government Agency") concerning any act or omission that you reasonably believe constitutes a possible violation of federal or state law or making other disclosures that are protected under the anti-retaliation or whistleblower provisions of applicable federal or state law or regulation. In addition, nothing

contained in this Agreement limits your ability to communicate with any Government Agency or otherwise participate in any investigation or proceeding that may be conducted by any Government Agency, including your ability to provide documents or other information, without notice to the Company. In addition, for the avoidance of doubt, pursuant to the federal Defend Trade Secrets Act of 2016, you shall not be held criminally or civilly liable under any federal or state trade secret law or under this Agreement or the Confidentiality Agreement for the disclosure of a trade secret that (a) is made (i) in confidence to a federal, state, or local government official, either directly or indirectly, or to an attorney; and (ii) solely for the purpose of reporting or investigating a suspected violation of law; or (b) is made in a complaint or other document filed in a lawsuit or other proceeding, if such filing is made under seal.

11. Termination of Payments

If you breach any of your obligations under this Agreement or Confidentiality Agreement, in addition to any other legal or equitable remedies it may have for such breach, the Company shall have the right to terminate its payments to you or for your benefit under this Agreement. The termination of such payments in the event of your breach will not affect your continuing obligations under this Agreement.

12. Non-Admission

This Agreement shall not be construed as an admission of any liability by the Company to you or of any act of wrongdoing by the Company.

13. Legally Binding

This Agreement is a legally binding document and your signature will commit you to its terms. The Company has advised you to consult with counsel before entering into this Agreement. You acknowledge that you have carefully read and fully understand all of the provisions of this Agreement and that you are voluntarily entering into this Agreement.

14. Absence of Reliance

In signing this Agreement, you are not relying upon any promises or representations made by anyone at or on behalf of the Company.

15. Enforceability

If any portion or provision of this Agreement (including, without limitation, any portion or provision of any section of this Agreement as well as any portion or provision of any section of the Confidentiality Agreement) shall to any extent be declared illegal or unenforceable by a court of competent jurisdiction, then the remainder of this Agreement, or the application of such portion or provision in circumstances other than those as to which it is so declared illegal or unenforceable, shall not be affected thereby, and each portion and provision of this Agreement shall be valid and enforceable to the fullest extent permitted by law.

16.Waiver

No waiver of any provision of this Agreement shall be effective unless made in writing and signed by the waiving party. The failure of any party to require the performance of any term or obligation of this Agreement, or the waiver by any party of any breach of this Agreement, shall not prevent any subsequent enforcement of such term or obligation or be deemed a waiver of any subsequent breach.

17.Jurisdiction

You and the Company hereby agree that the Superior Court of the Commonwealth of Massachusetts and the United States District Court for the District of Massachusetts shall have the exclusive jurisdiction to consider any matters related to this Agreement, including without limitation any claim for violation of this Agreement. With respect to any such court action, you (i) submit to the exclusive jurisdiction of such courts, (ii) consent to service of process, and (iii) waive any other requirement (whether imposed by statute, rule of court or otherwise) with respect to personal jurisdiction or venue.

18.Governing Law; Interpretation

This Agreement shall be interpreted and enforced under the laws of the Commonwealth of Massachusetts, without regard to conflict of law principles. In the event of any dispute, this Agreement is intended by the parties to be construed as a whole, to be interpreted in accordance with its fair meaning, and not to be construed strictly for or against either you or the Company or the "drafter" of all or any portion of this Agreement.

19.Entire Agreement; Effective Date

This Agreement constitutes the entire agreement between you and the Company. This Agreement supersedes any previous agreements or understandings between you and the Company except that the Employment Agreement, the Confidentiality Agreement, the Indemnification Agreement, the Equity Documents (each of the foregoing as modified herein), and any other obligations specifically preserved in this Agreement remain in full force and effect. This Agreement shall become effective on the date when it becomes fully executed (the "Effective Date").

20.Indemnification Agreement

Notwithstanding anything to the contrary in your Indemnification Agreement, the Company's obligations to indemnify you under the Indemnification Agreement shall apply to any action that you take while acting as an employee or independent contractor of the Company to the same extent as they apply to actions by you while acting as an officer of the Company.

21.Counterparts

This Agreement may be executed in any number of counterparts, each of which when so executed and delivered shall be taken to be an original, but all of which together shall constitute

one and the same document. Facsimile and PDF signatures shall be deemed to have the same legal effect as originals.

[Signature page follows]

Please indicate your agreement to the terms of this Agreement by signing and returning to Regina DeTore Paglia (rpaglia@dicerna.com) the original or a PDF of this letter.

Sincerely,

DICERNA PHARMACEUTICALS, INC.

By: /s/ Douglas M. Fambrough III, Ph.D February 27, 2020
Douglas M. Fambrough III, Ph.D. Date
President, Chief Executive Officer

The foregoing is agreed to and accepted by:

/s/ John B. Green February 27, 2020
John B. Green Date

Enclosures: Release Agreement (Exhibit A)
Confidentiality Agreement (Exhibit B)

EXHIBIT A

RELEASE AGREEMENT

Background

You acknowledge that in connection with the termination of your employment with Dicerna Pharmaceuticals, Inc. (the "Company"), you entered into a letter agreement with a letter date of February 21, 2020 (the "Transition Agreement"). All capitalized terms used and not defined herein shall have the same meanings as set forth in the Transition Agreement. You understand that this is the "Release Agreement" referenced in the Transition Agreement. **You understand that this Release Agreement shall be deemed tendered to you upon the Termination Date unless the Company substitutes a substantially identical release Agreement in place of this one and tenders such Release Agreement on or promptly after the Termination Date. You further understand that you may not sign this Release Agreement until after the Termination Date but that you must return it to the Company on or before the expiration of the Consideration Period (as defined below).**

Release and Related Terms

1. Release of Claims. In consideration for, among other terms, your eligibility for the Severance Benefits, which you acknowledge you would otherwise not be entitled, you voluntarily release and forever discharge the Company, its affiliated and related entities, including, without limitation, its and their respective predecessors, successors and assigns, its and their respective employee benefit plans and fiduciaries of such plans, and the current and former officers, directors, shareholders, partners, employees, attorneys, accountants and agents of each of the foregoing in their official and personal capacities (collectively referred to as the "Releasees") generally from all claims, demands, debts, damages and liabilities of every name and nature, known or unknown ("Claims") that, as of the date when you sign this Release Agreement, you have, ever had, now claim to have or ever claimed to have had against any or all of the Releasees. This release includes, without limitation, all Claims:

- relating to your employment with the Company;
- of wrongful discharge;
- of breach of contract;
- of retaliation or discrimination under federal, state or local law (including, without limitation, Claims of discrimination or retaliation under the Americans with Disabilities Act, the Age Discrimination in Employment Act, Title VII of the Civil Rights Act of 1964, and Massachusetts Gen. Law c. 151B);
- under any other federal or state statute;
- of defamation or other torts;
- of violation of public policy;

- for wages, bonuses, incentive compensation, commissions, stock, stock options, vacation pay or any other compensation or benefits, including under the Massachusetts Wage Act, M.G.L. c. 149, §§148-150C, or otherwise; and
- for damages or other remedies of any sort, including, without limitation, compensatory damages, punitive damages, injunctive relief and attorney's fees;

provided, however, that this release shall not affect your vested rights under the Company's 401(k) plan or your rights under the Release Agreement or the Transition Agreement.

You agree not to accept damages of any nature, other equitable or legal remedies for your own benefit or attorney's fees or costs from any of the Releasees with respect to any Claim released by this Release Agreement. As a material inducement to the Company to enter into this Release Agreement, you represent that you have not assigned any Claim to any third party.

2. Confidentiality Agreement. You acknowledge that your obligations under the Confidentiality Agreement shall continue in effect, including without limitation your obligations to maintain the confidentiality of Confidential Information as defined in the Confidentiality Agreement, to return documents and other property of the Company, to cooperate with the Company with respect to the procurement, maintenance and enforcement of intellectual property rights, and to refrain from certain competitive and solicitation activities for a period of two (2) years following the end of your employment; provided, however, that this Release Agreement hereby amends Sections 2, 3, and 4 in the Confidentiality Agreement such that the non-competition and non-solicitation covenants shall continue for two (2) years following the end of the Consulting Period. You acknowledge and agree that the terms and obligations of the Confidentiality Agreement are hereby incorporated by reference as material terms of this Release Agreement.

3. Termination of Payments. In the event that you breach any of your obligations under this Release Agreement or the Transition Agreement or otherwise fail to continue to satisfy the Conditions, in addition to any other legal or equitable remedies it may have for such breach, the Company shall have the right to terminate its payments to you or for your benefit under this Release Agreement or the Transition Agreement. The termination of such payments in the event of your breach will not affect your continuing obligations under this Release Agreement or the Transition Agreement.

4. Absence of Reliance. In signing this Release Agreement, you are not relying upon any promises or representations made by anyone at or on behalf of the Company, other than as set forth herein or in the Transition Agreement.

5. Enforceability. If any portion or provision of this Release Agreement (including, without limitation, any portion or provision of any section of this Release Agreement) shall to any extent be declared illegal or unenforceable by a court of competent jurisdiction, then the remainder of this Release Agreement, or the application of such portion or provision in circumstances other than those as to which it is so declared illegal or unenforceable, shall not be affected thereby, and each portion and provision of this Release Agreement shall be valid and enforceable to the fullest extent permitted by law.

6. Waiver. No waiver of any provision of this Release Agreement shall be effective unless made in writing and signed by the waiving party. The failure of a party to require the performance of any term or obligation of this Release Agreement, or the waiver by a party of any breach of this Release Agreement, shall not prevent any subsequent enforcement of such term or obligation or be deemed a waiver of any subsequent breach.

7. Time for Consideration; Release Effective Date. You acknowledge that you have knowingly and voluntarily entered into this Release Agreement and that the Company advises you to consult with an attorney before signing this Release Agreement. You understand and acknowledge that you have been given the opportunity to consider this Release Agreement for twenty-one (21) days from the day it was deemed tendered to you on the Termination Date before signing it (the "Consideration Period"). To accept this Release Agreement, you must return a signed original or a signed PDF copy of this Release Agreement so that it is received by Regina DeTore Paglia (rpaglia@dicerna.com) at or before the expiration of the Consideration Period. If you sign this Release Agreement before the end of the Consideration Period, you acknowledge that such decision was entirely voluntary and that you had the opportunity to consider this Release Agreement for the entire Consideration Period. For the period of seven (7) business days from the date when you sign this Release Agreement, you have the right to revoke this Release Agreement by written notice to Ms. DeTore Paglia, provided that such notice is delivered so that it is received at or before the expiration of the seven (7) business day revocation period. This Release Agreement shall not become fully effective during the revocation period. This Release Agreement shall become fully effective on the first business day following the expiration of the revocation period.

8. Protected Disclosures. Nothing contained in this Release Agreement or otherwise limits your ability to file a charge or complaint or communicate with any federal, state or local governmental agency or commission (a "Government Agency"). In addition, nothing contained in this Release Agreement or otherwise limits your ability to participate in any investigation or proceeding that may be conducted by any Government Agency, including your ability to provide documents or other information, without notice to the Company, nor does anything contained in this Release Agreement apply to truthful testimony. If you file any charge or complaint with any Government Agency and if the Government Agency pursues any claim on your behalf, or if any other third party pursues any claim on your behalf, you waive any right to monetary or other individualized relief (either individually, or as part of any collective or class action); provided that nothing in this Agreement limits any right that you may have to receive a whistleblower award or other bounty for information provided to the Securities and Exchange Commission.

9. Jurisdiction. You and the Company hereby agree that the Superior Court of the Commonwealth of Massachusetts and the United States District Court for the District of Massachusetts shall have the exclusive jurisdiction to consider any matters related to this Agreement, including without limitation any claim for violation of this Agreement. With respect to any such court action, you (i) submit to the exclusive jurisdiction of such courts, (ii) consent to service of process, and (iii) waive any other requirement (whether imposed by statute, rule of court or otherwise) with respect to personal jurisdiction or venue.

10. Governing Law; Interpretation. This Agreement shall be interpreted and enforced under the laws of the Commonwealth of Massachusetts, without regard to conflict of law principles. In the event of any dispute, this Release Agreement is intended by the parties to be construed as a whole, to be interpreted in accordance with its fair meaning, and not to be construed strictly for or against either you or the Company or the "drafter" of all or any portion of this Release Agreement.

11. Entire Agreement. This Release Agreement constitutes the entire agreement between you and the Company. This Release Agreement supersedes any previous agreements or understandings between you and the Company, except the Transition Agreement, the Confidentiality Agreement (as modified herein and in the Transition Agreement), the Equity Documents (as modified in the Transition Agreement), the Indemnification Agreement (as modified by the Transition Agreement) and any other obligations specifically preserved in this Release Agreement or the Transition Agreement.

[Signature page follows]

I HAVE READ THIS RELEASE AGREEMENT THOROUGHLY, UNDERSTAND ITS TERMS, HAVE HAD AT LEAST 21 DAYS TO CONSIDER IT BEFORE SIGNING, AND HAVE SIGNED IT KNOWINGLY AND VOLUNTARILY. I UNDERSTAND THAT THIS RELEASE AGREEMENT IS A LEGAL DOCUMENT. I ACKNOWLEDGE THAT I HAVE BEEN ADVISED BY THE COMPANY TO DISCUSS ALL ASPECTS OF THIS RELEASE AGREEMENT WITH MY ATTORNEY AND THAT I HAVE DONE SO IF I SO CHOOSE.

_____ _____

John B. Green Date

Accepted and agreed:

DICERNA PHARMACEUTICALS, INC.

By: __ __

Douglas M. Fambrough III, Ph.D. Date

President, Chief Executive Officer

Exhibit 21.1

SUBSIDIARIES OF DICERNA PHARMACEUTICALS, INC.

Name	Jurisdiction of Incorporation
Dicerna Security Corporation	Delaware
Dicerna EU Limited	England
Dicerna Ireland Limited	Ireland
Dicerna Germany GmbH	Germany

Exhibit 23.1

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We consent to the incorporation by reference in Registration Statements No. 333-234572 on Form S-3ASR, Nos. 333-202687, 333-214082, 333-223778, and 333-224989 on Form S-3 and in Registration Statement Nos. 333-193795, 333-210071, 333-223648, and 333-233149 on Form S-8 of our reports dated February 27, 2020, relating to the consolidated financial statements of Dicerna Pharmaceuticals, Inc. and the effectiveness of Dicerna Pharmaceuticals, Inc.'s internal control over financial reporting, appearing in this Annual Report on Form 10-K of Dicerna Pharmaceuticals, Inc. for the year ended December 31, 2019.

/s/ Deloitte & Touche LLP

Boston, Massachusetts
February 27, 2020

Exhibit 31.1

CERTIFICATIONS

I, Douglas M. Fambrough, III, Ph.D., certify that:

1. I have reviewed this Annual Report on Form 10-K of Dicerna Pharmaceuticals, Inc. for the year ended December 31, 2019;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: February 27, 2020

/s/ Douglas M. Fambrough, III, Ph.D.

Douglas M. Fambrough, III, Ph.D.

Chief Executive Officer and Director

Exhibit 31.2

CERTIFICATIONS

I, John B. Green, certify that:

1. I have reviewed this Annual Report on Form 10-K of Dicerna Pharmaceuticals, Inc. for the year ended December 31, 2019;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: February 27, 2020

/s/ John B. Green

John B. Green

Chief Financial Officer

Exhibit 32.1

SECTION 1350 CERTIFICATIONS*

Pursuant to the requirement set forth in Rule 13a-14(b) of the Securities Exchange Act of 1934, as amended (the "Exchange Act"), and Section 1350 of Chapter 63 of Title 18 of the United States Code (18 U.S.C. § 1350), Douglas M. Fambrough, III, Ph.D., Chief Executive Officer and Director of Dicerna Pharmaceuticals, Inc. (the "Company"), and John B. Green, Chief Financial Officer of the Company, each hereby certifies that, to the best of his knowledge:

1. The Company's Annual Report on Form 10-K, for the year ended December 31, 2019, to which this Certification is attached as Exhibit 32.1 (the "Annual Report"), fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended; and

2. The information contained in the Annual Report fairly presents, in all material respects, the financial condition and results of operations of the Company for the period covered by the Annual Report.

Dated: February 27, 2020

/s/ Douglas M. Fambrough, III, Ph.D.	/s/ John B. Green
Douglas M. Fambrough, III, Ph.D.	**John B. Green**
Chief Executive Officer and Director	**Chief Financial Officer**

* This certification accompanies the Annual Report on Form 10-K, to which it relates, is not deemed filed with the Securities and Exchange Commission and is not to be incorporated by reference into any filing of the Company under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended (whether made before or after the date of the Form 10-K), irrespective of any general incorporation language contained in such filing.