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UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, DC 20549

FORM 10-K

☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**
For the fiscal year ended December 31, 2018
or
☐ **TRANSITION REPORTS 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.)

87 Cambridgepark Drive, Cambridge, MA 02140
(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	Name of Each Exchange on Which Registered
Common Stock, $0.0001 par value	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 ☐ 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 ☒

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 ☒ 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 ☒ No ☐

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§ 229.405 of this chapter) is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ☒

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or 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	☐	Accelerated filer	☒
Non-accelerated filer	☐	Smaller reporting company	☒
		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 ☒

The aggregate market value of the registrant's common stock held by non-affiliates of the registrant on June 30, 2018 was approximately $442.8 million based on the last reported sale of the registrant's common stock on The Nasdaq Global Select Market on June 30, 2018 of $12.25 per share.

As of March 4, 2019, there were 68,264,949 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 2019 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.

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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:

- how long we expect to maintain liquidity to fund our planned level of operations and our ability to obtain additional funds for our operations;
- the initiation, timing, progress and results of our research and development programs, preclinical studies, any clinical trials and Investigational New Drug application ("IND"), Clinical Trial Application ("CTA"), New Drug Application ("NDA") and other regulatory submissions;
- our ability to identify and develop product candidates for 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 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;
- 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, Eli Lilly and Company ("Lilly"), Alexion Pharmaceuticals, Inc. (together with its affiliates, "Alexion"), and Boehringer Ingelheim International GmbH ("BI"), 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 expectations regarding the time during which we will be an emerging growth company under the Jumpstart Our Business Startups Act;
- 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.

PART I

ITEM 1. BUSINESS

Overview

Dicerna™ Pharmaceuticals, Inc. ("we," "us," "our," the "Company," or "Dicerna") is a biopharmaceutical company focused on the discovery and development of innovative, subcutaneously delivered ribonucleic acid ("RNA") interference ("RNAi")-based therapeutics using our GalXC™ RNAi platform for the treatment of diseases involving the liver, including rare diseases, viral infectious diseases, chronic liver diseases, and cardiovascular diseases. Within these therapeutic areas, we believe our GalXC RNAi platform will allow us to build a broad pipeline of therapeutics designed to have attractive pharmaceutical properties, including a subcutaneous route of administration, infrequent dosing (e.g., dosing that is monthly or quarterly, and potentially even less frequent), high therapeutic index, and target a single gene. Our key development programs include DCR-PHXC for the treatment of primary hyperoxaluria ("PH"), currently in a Phase 1 clinical trial with expected initiation of registration studies in the first quarter of 2019; DCR-HBVS for the treatment of chronic hepatitis B virus ("HBV"), currently in a Phase 1 clinical trial; and an undisclosed product candidate against a serious rare liver disease, currently in Clinical Trial Application ("CTA") or Investigational New Drug application ("IND") enabling studies. Dicerna intends to discover, develop, and commercialize novel therapeutics either on its own or in collaboration with pharmaceutical partners. Dicerna has strategic collaborations with 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 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 diseases involving the liver, including rare diseases, viral infectious diseases, chronic liver diseases, and cardiovascular diseases. We have qualified dozens of disease-associated genes with clinical indications, in which we believe an RNAi-based inhibitor may provide substantial benefit to patients by providing additional therapeutic opportunities.

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 viral infectious diseases, chronic liver diseases, and cardiovascular diseases; and (3) further leveraging our successes with the GalXC platform to explore non-hepatic therapeutic gene targets.
- **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 DCR-PHXC (which is in development for all forms of PH) and intend to demonstrate proof-of-concept for our other development programs starting in 2019. Based on precedents in the RNAi field, we are optimistic that our preclinical studies, which showed the significant knockdown of target mRNA activity lasting for up to three months after the last dose and disease biomarker activity, potentially may translate into beneficial clinical results for multiple 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 diseases with focused patient populations, such as certain rare diseases. These certain rare diseases represent opportunities that carry a relatively higher probability of success, with genetically and molecularly defined disease markets, high unmet need, a limited number of centers of excellence to facilitate reaching these patients, and the potential for more rapid clinical development programs.
- **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 larger patient populations, we plan to pursue collaborations that can provide the enhanced scale, resources, and commercial infrastructure required to maximize these prospects, such as our existing collaborative research and license agreements.

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 GalXC compounds developed to target hepatocytes in the liver are broadly applicable across multiple therapeutic areas, including rare diseases, chronic liver diseases, cardiovascular diseases, and viral infectious diseases. Our recent collaboration with Lilly provides both the opportunity to leverage our proprietary GalXC platform in order to generate new medicines for cardiometabolic diseases, and to target additional cell types to establish a presence in new therapeutic areas, including neurodegeneration and pain.
- **Continue to invest in and extend our RNAi technology platform and intellectual property.** We plan to continue to invest in expanding and improving our GalXC RNAi platform technology. We have a robust and growing patent portfolio that we believe covers our core technologies and our proprietary GalXC RNAi platform and other RNAi technologies. As of March 4, 2019, our worldwide patent estate, not including the patents and patent applications that we have licensed from third parties, included over 55 issued patents or allowed patent applications and at least 80 pending patent applications supporting commercial development of our RNAi molecules and delivery technologies.
- **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 the RNAi field through their substantial involvement in companies such as Cephalon Inc., Genta Inc., GlaxoSmithKline plc, Pfizer Inc., Sanofi S.A. ("Sanofi"), 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. ("Merck") in 2006 for $1.1 billion.

Our GalXC RNAi Technology Platform

The RNAi Therapeutic Modality

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 mRNA of a target gene that contains sequences that are complementary to one strand of the therapeutic double-stranded RNA molecule. Our GalXC RNAi platform utilizes a proprietary structure of double-stranded RNA molecules 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.

RNAi therapeutics represent a novel advance in drug development. Historically, the pharmaceutical industry has only developed small molecules or antibodies 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 antibodies. Some proteins lack the binding pockets small molecules require for interaction. Other proteins are solely intracellular and therefore inaccessible to antibody-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.

We believe our approach to RNAi drug development provides the following qualities and has advantages compared to other therapeutic modalities:

- **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 emerging pipeline of liver-targeted RNAi investigational therapies. The GalXC RNAi platform does not involve lipid nanoparticles ("LNPs") or other formulation components that facilitate drug delivery, which simplifies the platform and eliminates any requirement for functional excipients. Instead, our GalXC molecules are stabilized by chemical modifications and utilize a four base sequence known as a tetraloop, where each base is conjugated to a simple sugar, *N*-acetyl-D-galactosamine ("GalNAc"), that is specifically recognized by a receptor on the surface of hepatocyte liver cells. With the 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 liver 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 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 target gene silencing.

- **Therapeutic opportunities beyond the liver.** Our research suggests that GalXC compounds developed to target hepatocytes in the liver are broadly applicable across multiple therapeutic areas, including rare diseases, chronic liver diseases, cardiovascular diseases, and viral infectious diseases. Through our recent collaboration with Lilly, we intend to develop a new, non-hepatocyte platform, leveraging our proprietary GalXC platform, in order to generate new medicines for cardiometabolic diseases, and to target additional cell types to establish a presence in new fields, including neurodegeneration and pain.

Optimization of our GalXC molecules

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 RNAs, 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 modification, including a GalNAc-linked tetraloop stem-loop structure, which designs in enhanced stability and hepatocyte delivery specificity and engineers out immunostimulatory activity. Our 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 our programs.

Development Focus

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 most or all of these criteria:

- **Strength of therapeutic hypothesis.** Our current and future product candidate gene targets are a well understood part of the disease process where a therapeutic intervention is 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 genetic tests.
- **Predictivity of biomarkers for early efficacy assessment.** We seek disease indications where there is a clear relationship between the disease status and an associated biomarker that we can readily measure. This approach will 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 approval.** To reach commercialization expeditiously and to help ensure our ability to finance development of our product candidates, we have identified indications with the potential for rapid development through marketing approval. We believe that some of our product candidates have the potential to obtain breakthrough therapy designation as well as accelerated review process from the United States (“U.S.”) Food and Drug Administration (“FDA”).

We are focusing our efforts on three priority therapeutic programs that currently have a CTA filed, IND filed, or are in enabling studies in preparation to submit additional regulatory applications that will be necessary to initiate clinical trials. We are also focusing our efforts on a series of potential programs in the clinical candidate selection stage, or for which a provisional clinical candidate has been selected that may be elevated into IND/CTA enabling studies in the future, either on our own or in collaboration with larger pharmaceutical companies.

Our three priority programs are: DCR-PHXC for the treatment of PH; DCR-HBVS for the treatment of chronic HBV infection; and a program for an undisclosed rare disease. Our potential programs include additional rare disease programs, a program for the treatment of hypercholesterolemia, and multiple programs in various therapeutic areas involving liver function.

DCR-PHXC for PH

We are developing DCR-PHXC for the treatment of all types of PH. PH is a family of rare inborn errors of metabolism in which the liver produces excessive levels of oxalate, which in turn causes damage to the kidneys and to other tissues in the body. DCR-PHXC is currently being investigated in a Phase 1 clinical trial called PHYOX. In non-clinical models of PH, DCR-PHXC reduces oxalate production to near-normal levels, improving the disease condition.

PH encompasses three genetically distinct, autosomal-recessive, inborn errors of glyoxylate metabolism characterized by the over-production of oxalate, a highly insoluble metabolic end-product that is eliminated mainly by the kidneys. Patients with PH are predisposed to the development of multiple and recurrent urinary tract (urolithiasis) and kidney (nephrolithiasis) stones. Calculi formation is accompanied by nephrocalcinosis in some patients with PH (PH1 and some patients with PH2). This deposition of calcium oxalate 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.

PH1, PH2, and PH type 3 ("PH3"), are each characterized by a specific enzyme deficiency. PH1 is characterized by a deficiency of the liver peroxisomal enzyme alanine: glyoxylate-aminotransferase. Patients with PH1 represent approximately 80% of all patients currently diagnosed with PH. PH2 and PH3 are caused by dysfunction of glyoxylate reductase/hydroxypyruvate reductase and 4-hydroxy-2-oxoglutarate aldolase, respectively. Most patients are diagnosed 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 of the effects of the disease. Current medical management before renal failure develops is underpinned by hyperhydration with fluid intake recommendations of at least 3 liters 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 night time fluid administration. Affected patients are at considerable risk of serious 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 is used to inhibit crystallization and alkalinize the urine. In PH1, an approximately 30% or greater reduction in urinary oxalate excretion may be achieved with oral vitamin B6 (Pyridoxine) administration at doses from 5 to 20 mg/kg in a small proportion of affected patients (10-20% of all PH1 patients).

For patients with more advanced disease, dialysis may be used in an attempt to remove endogenously over-produced oxalate. In contrast to 3 times weekly hemodialysis regimens more typically used in other types of renal failure, patients with PH may require hemodialysis 6 or 7 days per week. Given the limitations of dialysis and the inability to impact oxalate over-production 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 include renal transplantation or, in PH1, combined liver and kidney transplantation. As with organ transplantation in other disease, 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 that there is a strong rationale for focusing our RNAi technology on the development of product candidates for the treatment of PH. DCR-PHXC, the Company's lead GalXC product candidate, was associated with normalization or near-normalization of urinary oxalate levels in a majority of adult patients with PH1 and PH2 following single-dose administration. As of a data cut on October 1, 2018, investigators reported that a single 3.0-mg/kg dose of DCR-PHXC brought urinary oxalate levels into the normal range (defined as 24-hour excretion <0.460 mmol) at one or more post-dose time points in three out of four PH participants dosed at this level, including a mean maximal reduction in 24-hour urinary oxalate of 65% for the cohort, and a single 1.5-mg/kg dose led to near-normalization (defined as 24-hour excretion ≥0.460 to <0.600 mmol) in three out of four PH1 participants dosed at this level, which led to a mean maximal reduction in urinary oxalate of 50% in the five PH patients dosed at that level, including one PH2 patient. In addition, DCR-PHXC, as of the October 1, 2018 data cut, was safe and well-tolerated in this ongoing study based on data from 12 adult participants with PH1 (n=11) and PH2 (n=1) and 25 adult HVs.

LDHA reduction has a near-linear correlation with oxalate reduction and offers a minimal metabolic intervention. These benefits of LDHA inhibition may translate into consistent therapeutic activity even in the event of a missed dose. There are numerous case reports of LDHA deficiency naturally occurring in humans, with no reported adverse effects due to deficiency in the liver.

DCR-HBVS for HBV

We have declared a GalXC RNAi platform-based product candidate, DCR-HBVS, are conducting formal non-clinical development studies, and have initiated a Phase 1 clinical trial. We received CTA approval from the New Zealand Medicines and Medical Devices Safety Authority in November 2018 and ethics approval from the Health and Disability Ethics Committee in December 2018 for a Phase 1 clinical trial in healthy volunteers and patients with chronic HBV. The Phase 1 study was initiated in December 2018 and the first participants were dosed on January 24, 2019. We anticipate human POC data to be available in the fourth quarter of 2019. In addition, we filed for regulatory clearance in Australia, Hong Kong, South Korea, and Thailand in December 2018.

Current therapies for HBV rarely lead to a long-term immunological cure as measured by the clearance of the hepatitis B surface antigen ("HBsAg") and sustained HBV deoxyribonucleic acid ("DNA") suppression in patient plasma or blood. DCR-HBVS targets HBV messenger RNA and leads to greater than 99% reduction in circulated HBsAg in mouse models of HBV infection. Based on preclinical studies, and only if we receive appropriate regulatory approval to begin human clinical trials, we hope to determine the potential of DCR-HBVS to reduce HBsAg expression and HBV DNA in HBV patients in a subcutaneous dosing paradigm.

According to the Hepatitis B Foundation, the World Health Organization estimates that globally, HBV is reported to be the most common serious liver infection with over 250 million patients chronically infected. Annual mortality directly linked to chronic HBV infection is estimated to be approximately 780,000 people with an estimated 650,000 of these deaths caused by cirrhosis and liver cancer as a result of chronic hepatitis B, and a further 130,000 of these deaths from complications associated with acute disease. Chronic HBV is characterized by the presence of the HBsAg for six months or more.

Nucleoside analogs and pegylated interferon regimens have been utilized to suppress the virus; however, while the regimens can offer long-term viral suppression if taken continuously, they do not provide a cure. The vast majority of treated patients do not achieve an immunological cure of chronic HBV infection under treatment with these agents. The chance of achieving a long-term immunological cure as measured by the clearance of HBsAg and sustained HBV DNA suppression may be possible with the introduction of novel drugs designed to reduce intrahepatic and serum HBsAg, as well as HBV DNA.

An undisclosed rare disease involving the liver

We are developing a GalXC-based therapeutic targeting a liver-expressed gene involved in a serious rare disease. For competitive reasons, we have not yet publicly disclosed the target gene or disease. We have selected this target gene and disease based on criteria that include having a strong therapeutic hypothesis, a readily-identifiable patient population, the availability of a potentially predictive biomarker, high unmet medical need, favorable competitive positioning and what we believe is a rapid projected path to approval. The disease is a genetic disorder where mutations in the disease gene lead to the production of an abnormal protein. The protein causes progressive liver damage and fibrosis, in some cases leading to cirrhosis and liver failure, and we believe that silencing of the disease gene will prevent production of the abnormal protein and thereby slow or stop progression of the liver fibrosis. Greater than 100,000 people in the U.S. are believed to be homozygous for the mutation that causes the liver disease, and at least 10% of those people, and potentially a significantly higher fraction, are believed to have liver-associated disease as a consequence. We intend to submit regulatory filings in the second quarter of 2019.

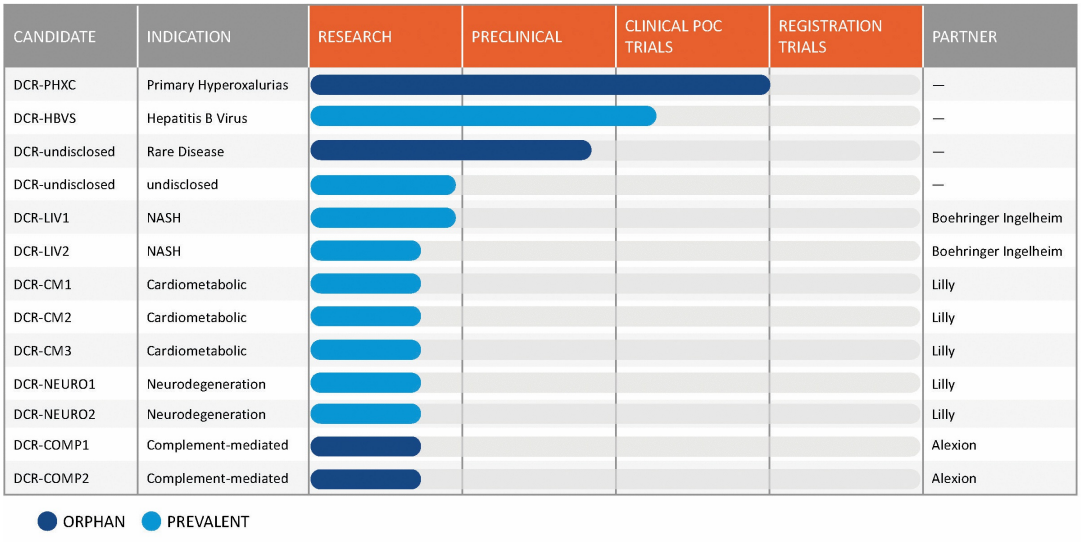
Additional pipeline programs

We have developed a robust portfolio of additional targets and diseases that we plan to pursue either on our own or in collaboration with partners. We have applied our GalXC technology to multiple gene targets across our disease focus areas of rare diseases, chronic liver diseases, and cardiovascular diseases. Pursuant to our strategy, we have established and continue to seek collaborations with larger, experienced pharmaceutical companies to advance our programs in the areas of chronic liver diseases and cardiovascular diseases, as well as select rare diseases that do not fit our criteria for a priority development program. The chronic liver and cardiovascular disease areas represent large and diverse patient populations, requiring complex clinical development and commercialization paths that we believe can be more effectively pursued in collaboration with larger pharmaceutical companies. For our additional rare diseases, we are continuing to assess their potential for clinical success and market opportunity while optimizing our GalXC molecules. For our additional pipeline programs, we may utilize more advanced versions of our GalXC technology that further improve pharmaceutical properties of the GalXC molecules, including enhancing the duration of action and potency. We have further optimized our GalXC technology platform, enabling the development of next generation GalXC molecules. Improvements to our GalXC compound include modification of the tetraloop end of the molecule, which can be applied to any target gene, resulting in a substantially longer duration of action and higher potency of target gene silencing in animal models across multiple targets. Modification of the tetraloop only impacts the passenger strand and does not impact the guide strand. These modifications are unique to our GalXC molecules and, we believe, provide a competitive advantage for us.

Other development programs

We also have developed a wholly-owned clinical candidate, DCR-BCAT, targeting the β-catenin oncogene. DCR-BCAT is based on an extended version of our earlier generation non-GalXC RNAi technology and is delivered by our LNP tumor delivery system, EnCore™. We plan to out-license the DCR-BCAT opportunity, given our focus on our GalXC platform-based programs.

The table below sets forth the state of development of our various GalXC RNAi platform product candidates as of March 4, 2019:



Status of Dicerna Programs

- **Primary Hyperoxaluria.** We are developing DCR-PHXC for the treatment of all types of PH. Our Phase 1 clinical trial called PHYOX™ has completed dosing. PHYOX is a Phase 1 single ascending-dose study of DCR-PHXC in healthy volunteers ("HVs") and study participants with PH. The study is divided into two groups:
  - Group A is a placebo-controlled, single-blind, single center study which enrolled 25 HVs.
  - Group B is an open-label, multi-center study enrolling up to 18 participants with PH type 1 ("PH1") or PH type 2 ("PH2"). The primary objective of the study is to evaluate the safety and tolerability of single of DCR-PHXC in both groups. The secondary objectives are to evaluate the pharmacodynamic effect of single doses of DCR-PHXC on biochemical markers, and to characterize the pharmacokinetics of single doses of DCR-PHXC in HVs and study participants with PH.

  In May 2018, we dosed the first PH study participant with DCR-PHXC in the Group B portion of the Phase 1 clinical trial and received notice from the U.S. FDA granting Orphan Drug Designation to DCR-PHXC for treatment of PH. In August 2018, the European Medicines Agency ("EMA")'s Committee for Orphan Medicinal Products ("COMP") designated DCR-PHXC as an orphan medicinal product for the treatment of PH in the European Union ("EU"). Currently, we are in the process of submitting requests for additional regulatory clearances necessary to commence clinical trials for our Phase 2 and Phase 3 studies in 2019. Key regulatory interactions with the FDA and EMA in anticipation of Phase 2 and Phase 3 studies are also underway.

  We completed the Group A portion of the study in HVs and started the Group B portion of the study. Group B consists of participants with PH1 dosed at 1.5, 3.0, and 6.0-mg/kg, and participants with PH2 at a dose level of 1.5 and 3.0-mg/kg. As of January 17, 2019, we had dosed all 18 participants (15 PH1 participants and three PH2 participants). We reported interim results from the PHYOX trial on September 5, 2018 and presented updated results as of October 1, 2018 at Kidney Week in San Diego on October 25, 2018.

  As of November 2018, three serious adverse events ("SAEs") have occurred in two participants (one subject experienced two discreet SAEs) in the PHYOX trial; none of these SAEs are related to the study intervention. There have been no clinically significant changes in electrocardiography, vital signs, laboratory, or hematology values. The investigators have observed in a total of 32 participants dosed (Group A and B together) mild-to-moderate injection site reactions in nine participants (28%), all of which were transient and resolved without intervention within 24 to 72 hours.

  As of a data cut on October 1, 2018, investigators reported that a single 3.0-mg/kg dose of DCR-PHXC brought urinary oxalate levels into the normal range (defined as 24-hour excretion <0.460 mmol) at one or more post-dose time points in three out of four PH participants dosed at this level, including a mean maximal reduction in 24-hour urinary oxalate of 65% for the cohort, and a single 1.5-mg/kg dose led to near-normalization (defined as 24-hour excretion ≥0.460 to <0.600

mmol) in three out of four PH1 participants dosed at this level, and led to a mean maximal reduction in urinary oxalate of 50% in the five PH patients dosed at that level, including one PH2 patient.

Additionally, we intend to initiate a multi-dose study, which we hope will serve as a registration trial, in the first quarter of 2019, pending regulatory feedback.

- **Chronic Hepatitis B Virus infection.** We have declared a GalXC RNAi platform-based product candidate for the treatment of chronic HBV, DCR-HBVS, and have initiated a Phase 1 clinical trial. We received CTA approval from the New Zealand Medicines and Medical Devices Safety Authority in November 2018 and ethics approval from the Health and Disability Ethics Committee in December 2018 for a Phase 1 clinical trial in HVs and patients with chronic HBV. The Phase 1 study was initiated in December 2018 and the first participant was dosed on January 24, 2019. We anticipate human POC data to be available in the fourth quarter of 2019. In addition, we filed for regulatory clearance in Australia, Hong Kong, South Korea, and Thailand in December 2018.

  Current therapies for HBV rarely lead to a long-term immunological cure as measured by the clearance of HBsAg and sustained HBV DNA suppression in patient plasma or blood. DCR-HBVS targets HBV mRNA and leads to greater than 99% reduction in circulated HBsAg in mouse models of HBV infection. DCR-HBVS is comprised of a single GalXC molecule that targets HBV mRNAs within the HBsAg gene sequence region. In preclinical studies with a standard mouse model of HBV infection, we have found that targeting this region leads to superior HBsAg suppression, both in magnitude and duration of suppression, compared to targeting within the X gene sequence region. We believe that this difference in suppression derives from the role of the X gene product in indirectly regulating viral gene transcription such that the lack of X gene product leads to higher levels of viral gene transcription. Based on our preclinical studies, we hope to determine the potential of DCR-HBVS to reduce HBsAg and HBV DNA levels in the blood of HBV patients in a commercially attractive subcutaneous dosing paradigm.

- **An undisclosed rare disease involving the liver.** We are developing a GalXC-based therapeutic, targeting a liver-expressed gene involved in a serious rare disease. For competitive reasons, we have not yet publicly disclosed the target gene or disease. The disease is a genetic disorder where mutations in the disease gene lead to the production of an abnormal protein. The protein causes progressive liver damage and fibrosis, in some cases leading to cirrhosis and liver failure, and we believe that silencing of the disease gene will prevent production of the abnormal protein and thereby slow or stop progression of the liver fibrosis. We intend to submit regulatory filings in the second quarter of 2019.

- **Additional pipeline programs.** We have developed a robust portfolio of additional targets and diseases that we plan to pursue either on our own or in collaboration with partners. We have applied our GalXC technology to multiple gene targets across our disease focus areas of rare diseases, chronic liver diseases, and cardiovascular diseases.

  Pursuant to our strategy, we are seeking collaborations with larger and/or more experienced pharmaceutical companies to advance our programs in the areas of chronic liver diseases and cardiovascular diseases, as well as select rare diseases that do not fit our criteria for a priority development program. The chronic liver and cardiovascular disease areas represent large and diverse patient populations, requiring complex clinical development and commercialization paths that we believe can be more effectively pursued in collaboration with larger pharmaceutical companies. Certain rare diseases require complex clinical development and commercialization paths aligned with existing treatment paradigms that we believe can be more effectively pursued in collaboration with companies possessing certain rare disease expertise.

  For our additional rare disease opportunities, we are continuing to assess their potential for clinical success and market opportunity while optimizing our GalXC molecules. For our additional pipeline programs, we may utilize more advanced versions of our GalXC technology that further improve pharmaceutical properties of the GalXC molecules, including enhancing the duration of action and potency. We have further optimized our GalXC technology platform, enabling the development of next generation GalXC molecules. Improvements to our GalXC compound include modification of the tetraloop end of the molecule, which can be applied to any target gene, resulting in a substantially longer duration of action and higher potency of target gene silencing in animal models across multiple targets. Modification of the tetraloop only impacts the sense strand and does not impact the antisense strand. These modifications are unique to our GalXC molecules and, we believe, provide a competitive advantage for the Company.

Partner Development Programs

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 (i.e., non-hepatocyte) 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, non-creditable upfront payment of $100.0 million, and made a concurrent stated $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. Through December 31, 2018, no revenue has been recognized associated with the Lilly Collaboration Agreement.

Alexion Collaboration

On October 22, 2018, we and Alexion entered into a Collaborative Research and License Agreement (the "Alexion Collaboration Agreement") 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 subcutaneously delivered GalXC candidates, currently in preclinical development, 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 through the completion of Phase 1, the costs of which 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 also provides Alexion with exclusive worldwide licenses as well as development and commercial rights for two of our preclinical, subcutaneously delivered GalXC RNAi candidates and an exclusive option for the discovery and development of GalXC RNAi candidates against two additional complement pathway targets.

Under the terms of the Alexion Collaboration Agreement, Alexion paid us a non-refundable, non-reimbursable, and non-creditable upfront payment of $22.0 million, with Alexion Pharmaceuticals making a concurrent stated $15.0 million equity investment in Dicerna at a premium pursuant to a share issuance agreement between the parties (the "Alexion Share Issuance Agreement"). The Alexion Collaboration Agreement also provides for potential additional payments to us of up to $600.0 million from proceeds from target option exercises and development and sales milestones, as defined in the agreement, which is comprised of option exercise fees of up to $20.0 million, representing $10.0 million for each of the 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. Through December 31, 2018, we recognized $0.1 million in revenue associated with the Alexion Collaboration Agreement.

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 an initial undisclosed target gene and includes an option for BI to add the development of product candidates that target a second gene (the "Additional Target"). We are working exclusively with BI to develop the product candidates against the undisclosed target gene. We are responsible for the discovery and initial profiling of the product candidates, including primary preclinical studies, synthesis, and delivery. 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. 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, we will be reimbursed by BI up to an agreed-upon limit for the cost of materials and third-party expenses that have been included in the preclinical studies. 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 on potential global net sales, subject to certain adjustments, tiered from high single digits up to low double-digits.

In October 2018, BI exercised its option under the BI Agreement to add the development of product candidates targeting an Additional Target to the development activities governed by the BI Agreement. On December 31, 2018, we entered into an Additional Target Agreement (the "ATA") with BI. The ATA requires the parties to agree on a research work plan and budget for the Additional Target. The ATA also amends the BI Agreement to provide BI with the option to add the development of product candidates targeting a further additional undisclosed gene target for a three-year period, and to provide for the delivery of a replacement product candidate by us to BI in the event that a product candidate under the BI Agreement or the ATA fails at certain stages of preclinical or clinical development.

Under the terms of the ATA, in accordance with the terms of the BI Agreement, and upon agreement of a research work plan and budget, BI agreed to pay us a non-refundable upfront payment of $5.0 million to exercise its initial option for development related to the Additional Target. 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 Additional 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 Additional Target will be subject to the terms of the BI Agreement. Under the ATA, if BI elects to exercise the second option, the parties would agree to a research work plan and budget for the additional gene and negotiate development and commercialization milestones and royalty payments to Dicerna. BI would make another option fee payment to us of $5.0 million. Through December 31, 2018, we recognized $7.1 million in revenue associated with the BI Agreement.

License Agreements

In December 2014, we licensed all of our non-U.S. intellectual property rights to a non-U.S. wholly-owned subsidiary. In December 2015, we licensed our U.S. intellectual property rights to the same non-U.S. wholly-owned subsidiary. In December 2016, the same non-U.S. wholly-owned subsidiary distributed the U.S. intellectual property rights back to us. In 2017, we amended a licensing agreement with the non-U.S. subsidiary to exclude from the scope and operation of that agreement the intellectual property licensed to BI pursuant to the BI Agreement. As such, effective October 27, 2017 certain rights associated with the BI Agreement reverted to us.

Intellectual Property

We are seeking multifaceted and multi-layered protection for our intellectual property 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.

Patents and proprietary rights

We own U.S. patents and a number of 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: 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). We also own numerous patents and patent applications covering specific RNAi sequences that drive activity against 12 high value disease targets, including targets for our key 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 at least 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. 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 technology.

We cannot predict with any certainty if any third-party U.S. or foreign patent rights, 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. 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.

Our success will depend in part on our ability to obtain and maintain patent protection, preserve trade secrets, prevent third parties from infringing upon our proprietary rights, and operate without infringing upon the proprietary rights of others, both in the U.S. and other territories worldwide.

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 other companies 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:

- Other companies working to develop RNAi therapeutic products;
- Companies developing technology known as antisense, which, similar to the RNAi therapy we use, attempts to silence specific genes; and
- Commercialized products and product candidates, as well as development programs that treat the same diseases for which we are also developing treatments.

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 higher efficacy 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. The current standard of care for treating PH1 is a dual-organ transplant, specifically a kidney and liver transplant in patients with PH1, which is often difficult to perform due to lack of donors and the threat of organ rejection. Other treatments include pyridoxine regimens and intensive dialysis, as well as treatments

generally used in kidney stone disorders such as high-volume fluid intake and oral citrate. These other treatments do not halt disease progression.

We believe that the following product candidates, if approved, could compete with DCR-PHXC:

Company	Drug	Drug Description	Phase
Alnylam Pharmaceuticals, Inc.	Lumasiran (formerly ALN-GO1)	RNAi therapeutic targeting glycolate oxidase	Phase 3
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, such as Intellia Therapeutics, Inc.

Hepatitis B Virus

Nucleoside analogs and pegylated interferon regimens have been utilized in order to suppress the hepatitis B virus in patients with chronic HBV infection. However, while these regimens can offer long-term viral suppression, they do not provide a cure, and they usually require lifelong therapy. A finite treatment option with the chance of achieving a long-term immunological cure, as measured by the clearance of HBsAg and sustained HBV DNA suppression, may be possible with the introduction of novel drugs designed to reduce intrahepatic and serum HBsAg, as well as HBV DNA.

We believe that the following product candidates, if approved, could compete with DCR-HBVS:

Company	Drug	Drug Description	Phase
Alnylam Pharmaceuticals, Inc. *Partner: Vir Biotechnology*	ALN-HBV02	RNAi-GalNAc conjugate	Phase 1/2
Arbutus Biopharma	ARB-1467	RNAi lipid nanoparticle formulation	Phase 2
Arbutus Biopharma	AB-729	RNAi-GalNAc conjugate	Preclinical
Arrowhead Pharmaceuticals, Inc. *Partner: Janssen*	ARO-HBV	RNAi-GalNAc conjugate	Phase 1
Ionis Pharmaceuticals, Inc. *Partner: GlaxoSmithKline*	IONIS-HBVRx	RNA-targeted antisense technology	Phase 2
Ionis Pharmaceuticals, Inc. *Partner: GlaxoSmithKline*	IONIS-HBV-L_{Rx}	Antisense oligonucleotide-GalNAc conjugate	Phase 2
F. Hoffman-La Roche, Ltd	RG6004	Antisense oligonucleotide-GalNAc conjugate	Phase 1

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

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. 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.

Presently, some of the drug starting materials for our manufacturing activities are supplied by a single source supplier and we are in the process of identifying secondary suppliers. We believe that adequate alternative sources for such supplies exist; however, there is a risk that, if supplies are interrupted, it would materially harm our business. We typically order raw materials and services on a purchase order basis and do not enter into long-term dedicated capacity or minimum supply arrangements.

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.

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:

- "primarily affects individuals aged from birth to 18 years, including age groups often called neonates, infants, children, and adolescents," which is interpreted as meaning that greater than 50% of the affected population in the U.S. is aged 0 through 18 years; 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

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. 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. 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 that may reduce the profitability of drug products such as expanding and increasing industry rebates for drugs covered under Medicaid programs and making changes to the coverage requirements under the Medicare Part D program. 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 newly enacted federal

income tax law 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." Congress may consider other legislation that would alter other aspects of the ACA. In addition, at least one U.S. District Court has ruled that the ACA is unconstitutional, and while the ruling was stayed pending appellate review, it is uncertain whether the ruling will be affirmed, and if affirmed, whether all or some of the ACA would then survive.

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, criminal fines for violations of the Anti-Kickback Statute increase from $25,000 to $100,000 and corresponding prison sentences also increase from no more than five years to no more than ten years.

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. 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 any scheduled increases in the prices of their products if they exceed 16% over a two-year period, and further requiring pharmaceutical companies to explain the reasons for such increases. Effective in 2016, Vermont passed a law requiring 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 U.S. Department of Health and Human Services (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).

Additionally, on January 31, 2019, the Department of Health and Human Services ("HHS") and HHS Office of Inspector General ("OIG") proposed an amendment to one of the existing Anti-Kickback safe harbors (42 C.F.R. 1001.952(h)) which would prohibit certain pharmaceutical manufacturers from offering rebates to pharmacy benefit managers ("PBMs") in the Medicare Part D and Medicaid managed care programs. The proposed amendment would remove protection for "discounts" from Anti-Kickback enforcement action, and would include criminal and civil penalties for knowingly and willfully offering, paying, soliciting, or receiving remuneration to induce or reward the referral of business reimbursable under federal health care programs. At the same time, HHS also proposed to create a new safe harbor to protect point-of-sale discounts that drug manufacturers provide directly to patients, and adds another safe harbor to protect certain administrative fees paid by manufacturers to PBMs. If this proposal is adopted, in whole or in part, it could affect the pricing and reimbursement for any products for which we receive approval in the future.

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. Historically, pharmaceutical and other healthcare companies have been prosecuted under these laws for allegedly providing free product to customers with the expectation that the customers would bill federal programs for the product. Other companies have been prosecuted for causing false claims to be submitted because of the companies' marketing of the product for unapproved, off-label, and thus generally non-reimbursable, uses.

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, such as Massachusetts, 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. 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, 2018, we had 78 full-time employees, of whom 49 are engaged in research and development and 29 in administration. None of our employees are represented by a labor union or covered by a collective bargaining agreement. Geographically, 66 of our employees are located in Massachusetts, nine in Colorado, one in New Jersey, one in New York, and one in North Carolina.

Corporate Information

We were incorporated in Delaware in 2006. We maintain our executive offices at 87 Cambridgepark Drive, Cambridge, MA 02140, 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.

We are an "emerging growth company" as defined in the Jumpstart Our Business Startups Act of 2012. We will remain an emerging growth company until the earlier of: (1) the last day of the fiscal year (a) following the fifth anniversary of the completion of our initial public offering on January 30, 2014, (b) in which we have total annual gross revenue of at least $1.07 billion, or (c) in which we are deemed to be a large accelerated filer, which means the market value of our common stock that is held by non-affiliates exceeds $700.0 million as of the prior June 30th, and (2) the date on which we have issued more than $1.0 billion in non-convertible debt during the prior three-year period. We refer to the Jumpstart Our Business Startups Act of 2012 herein as the "JOBS Act," and references herein to "emerging growth company" shall have the meaning associated with it in the JOBS Act.

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, and sales 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, 2018, we had $302.6 million in cash, cash equivalents, and held-to-maturity investments. Subsequently, we received an upfront payment in the amount of $5.0 million from Boehringer Ingelheim ("BI"), in connection with BI's exercise of its initial option under the Company's collaboration with BI, an upfront payment in the amount of $100.0 million from the Company's recent collaboration with Eli Lilly and Company ("Lilly"), also made the Company's final payment to Alnylam Pharmaceuticals, Inc. ("Alnylam") in the amount of $10.5 million pursuant to a Confidential Settlement Agreement and General Release. Based on our current operating plan and liquidity, the Company believes that our available cash, cash equivalents, and held-to-maturity investments will be sufficient to fund the execution of our current clinical and operating plan beyond 2020. However, to the extent our clinical and operating plan changes, and to fund our operations beyond 2020, 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, 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 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 foreseeable 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, extremely 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, our status as a smaller reporting company under SEC regulations, 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, 2018, we had an accumulated deficit of $404.8 million. For the years ended December 31, 2018, 2017, and 2016, our net loss attributable to common stockholders was $88.9 million, $80.3 million, and $59.5 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 litigation expenses associated with the 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 foreseeable 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 initiating or conducting, or release of 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 collaborator BI;
- 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;
- if any of our third-party manufacturers fail to execute on our manufacturing requirements or perform in accordance with cGMP;
- 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 cardiovascular 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 DCR-PHXC, 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 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;
- our ability to compliantly market and sell our products; 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 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.

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, makes a major contribution to patient care, or meets certain other criteria.

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's Committee for Orphan Medicinal Products designated DCR-PHXC as an orphan medicinal product for the treatment of PH in the EU. 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 early stages of development and may fail or suffer delays that materially and adversely affect their commercial viability.

We currently have no products on the market and all of our product candidates are in early 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, 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 and other non-clinical tests and clinical trials to demonstrate the safety and efficacy of our product candidates in humans. Non-clinical 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.

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 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 failure 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;
- 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.

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 Lilly, an affiliate of Alexion Pharmaceuticals, Inc. (together with its affiliates, "Alexion"), and BI (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 BI's 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. Our manufacturing requirements include oligonucleotides and custom amidites, some of which we procure from a single source supplier 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.

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 current good manufacturing practices ("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 BI, Alexion, and Lilly, 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 new or existing 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 goodwill 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. 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. 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.

We also compete with companies working to develop antisense and other RNA-based drugs. 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, and antisense technology may become the preferred technology for products that target mRNAs. Significant competition also exists from companies such as Alnylam and Arrowhead to discover and develop safe and effective means to deliver therapeutic RNAi molecules to the relevant cell and tissue types.

Many of our competitors have significantly greater financial, technical, manufacturing, marketing, sales and supply resources or experience than we have. 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 and 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. Competitors could also recruit our employees, which could negatively impact our level of expertise and our ability to execute our business plan.

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; John B. Green, our chief financial officer; and James B. Weissman, our chief business 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.

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

We have limited experience in drug development and very limited experience 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, suppliers, and other organizations. 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.

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 no sales, marketing, or distribution capabilities or experience. If any of our product candidates are approved, we will need to develop internal 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 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 services 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 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 voters approved an exit from the EU, commonly referred to as "Brexit." The withdrawal of the UK from the EU will take effect either on the effective date of the withdrawal agreement or, in the absence of agreement, two years after the UK provides a notice of withdrawal pursuant to the EU Treaty. On March 29, 2017, the Prime Minister of the UK delivered a formal notice of withdrawal to the EU. On May 22, 2017, the Council of the EU (the "Council"), adopted a decision authorizing the opening of Brexit negotiations with the UK and formally nominated the European Commission as EU negotiator. The Council also adopted negotiating directives for the talks, which began on April 18, 2018. Because of the regulatory uncertainty surrounding Brexit, we have established a subsidiary in Ireland for ongoing regulatory initiatives in the EU.

The ongoing developments following from the UK's public referendum vote to exit from the EU could cause disruptions to and create uncertainty surrounding our business, including affecting our relationships with existing and potential suppliers, manufacturers, and other third parties. Negotiations have commenced to determine the terms of the UK's future relationship with the EU, including the terms of trade between the UK and the EU. The effects of Brexit will depend upon any agreements the UK makes to retain access to EU markets either during a transitional period or more permanently. The measures could potentially have corporate structural consequences, adversely change tax benefits or liabilities in these or other jurisdictions and could disrupt some of the markets and

jurisdictions in which we operate. In addition, Brexit could lead to legal uncertainty and potentially divergent national laws and regulations as the UK determines which EU laws to replace or replicate. In addition, the announcement of Brexit has caused significant volatility in global stock markets and currency exchange rate fluctuations, including the strengthening of the USD against some foreign currencies, and the Brexit negotiations may continue to cause significant volatility. The progress and outcomes of Brexit negotiations also may create global economic uncertainty. Any of these effects of Brexit, among others, could materially adversely affect the business, business opportunities, and financial condition of our company.

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 the 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 could cause interruptions of our operations. 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. 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, our data, or inappropriate disclosure of confidential or proprietary information of the Company or patients, we could incur liability and the development of our product candidates could be delayed.

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 facilities in Cambridge, 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 Cambridge facilities comply with the relevant guidelines of Cambridge, 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.

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 facilities located in Cambridge, 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 December 2017. While this analysis is still preliminary, it is likely that our net operating losses are subject to such limitation. As of December 31, 2018, 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 and 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, 2018, we had $302.6 million in cash and 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 March 4, 2019, our worldwide patent estate, not including the patents and patent applications that we have licensed from third parties, included over 55 issued patents or allowed patent applications and at least 80 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 2002/044895, 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 interference, re-examination, opposition, post-grant review, *inter partes* review, nullification, derivation action, 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, 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. 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 very 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, once our therapeutic candidates or clinical trials are covered by federal healthcare programs, 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 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 U.S. federal Anti-Kickback Statute, which prohibits, among other things, persons from soliciting, receiving, offering, or providing remuneration, directly or indirectly, overtly or covertly, in cash or in kind, to induce 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;
- 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 for knowingly presenting or causing to be presented, to the federal government, claims for payment that are false or fraudulent or making a false statement to avoid, decrease, or conceal an obligation to pay money to the

federal government. 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 referred to as the HIPAA All-Payor Fraud Law, which imposes criminal and civil liability for executing a scheme to defraud any healthcare benefit program, 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. 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;
- federal and state consumer protection and unfair competition laws, which broadly regulate marketplace activities and activities that potentially harm consumers;
- the federal Physician Payment Sunshine Act and the implementing regulations, also referred to as "Open Payments," issued under 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," which require that manufacturers of pharmaceutical and biological drugs reimbursable under Medicare, Medicaid, and Children's Health Insurance Programs report to the Department of Health and Human Services all consulting fees, travel reimbursements, research grants, and other payments, transfers of value, or gifts made to physicians and teaching hospitals with limited exceptions;
- 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. Some states, such as California, Massachusetts and Vermont, mandate implementation of corporate compliance programs, along with the tracking and reporting of gifts, compensation, and other remuneration to physicians; and
- the EU General Data Protection Regulation ("GDPR"), which was officially adopted in April 2016 and went into effect in May 2018, introduces new data protection requirements in the EU, as well as substantial fines for breaches of the data protection rules. 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 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;
- 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.

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. 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, 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.

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.

For example, in the U.S., 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 President Trump 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;
- 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. The Trump administration and CMS have both stated that the ruling will have no immediate effect, and on December 30, 2018, the same judge issued an order staying the judgment pending appeal. It is unclear how this decision and any subsequent appeals and other efforts to repeal and replace the ACA will impact the ACA and our business. 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, President Trump 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 Trump 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 billion in ACA risk corridor payments to third-party payors who argued were owed to them. The effects of this gap in reimbursement on third-party payors, the viability of the ACA marketplace, providers, and potentially our business, are not yet known.

Also, in 2018, the Right to Try Act of 2018 provides a federal framework for certain patients 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.

The healthcare industry is heavily regulated in the U.S. at the federal, state, and local levels, and our failure to comply with applicable requirements may subject us to penalties and negatively affect our financial condition.

As a healthcare company, our operations, clinical trial activities, and interactions with healthcare providers may be subject to extensive regulation in the U.S., particularly if we receive FDA approval for any of our products in the future. For example, if we receive FDA approval for a product for which reimbursement is available under a federal healthcare program (e.g., Medicare, Medicaid), it would be subject to a variety of federal laws and regulations, including those that prohibit the filing of false or improper claims for payment by federal healthcare programs (e.g., the federal FCA), prohibit unlawful inducements for the referral of business reimbursable by federal healthcare programs (e.g., the federal Anti-Kickback Statute), and require disclosure of certain payments or other transfers of value made to U.S.-licensed physicians and teaching hospitals or Open Payments. We are not able to predict how

third parties will interpret these laws and apply applicable governmental guidance and may challenge our practices and activities under one or more of these laws. If our past or present operations are found to be in violation of any of these laws, we could be subject to civil and criminal penalties which could hurt our business, our operations, and financial condition.

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 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 pharmaceutical 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. Our practices may not in all cases meet all of the criteria for protection under a statutory exception or regulatory safe harbor.

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 FCA (discussed below).

The civil monetary penalties statute imposes penalties against any person or entity that, among other things, is determined to have presented or caused to be presented a claim to a federal healthcare program that the person knows or should know is for an item or service that was not provided as claimed or is false or fraudulent.

Federal false claims and false statement laws, including the federal FCA, prohibit, among other things, any person or entity from 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. For instance, historically, pharmaceutical and other healthcare companies have been prosecuted under these laws for allegedly providing free product to customers with the expectation that the customers would bill federal programs for the product. Other companies have been prosecuted for causing false claims to be submitted because of the companies’ marketing of the product for unapproved, off-label, and thus generally non-reimbursable, uses.

HIPAA prohibits, among other offenses, knowingly and willfully executing a scheme to defraud any healthcare benefit program, including private payors, or falsifying, concealing, or covering up a material fact, or making any materially false, fictitious, or fraudulent statement in connection with the delivery of or payment for items or services under a healthcare benefit program. To the extent that we act as a business associate to a healthcare provider engaging in electronic transactions, we may also be subject to the privacy and security provisions of HIPAA, as amended by HITECH, which restricts the use and disclosure of patient-identifiable health information, mandates the adoption of standards relating to the privacy and security of patient-identifiable health information, and requires the reporting of certain security breaches to healthcare provider customers with respect to such information. Additionally, many states have enacted similar laws that may impose more stringent requirements on entities like ours. Failure to comply with applicable laws and regulations could result in substantial penalties and adversely affect our financial condition and results of operations.

Also, many states have similar 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 is sold in a foreign country, we may be subject to similar foreign laws.

Certain Dicerna products, if approved, may be eligible for coverage under Medicare and Medicaid, among other government healthcare programs. Accordingly, Dicerna may be subject to a number of obligations based on its participation in these programs, such as a requirement to calculate and report certain price reporting metrics to the government, such as average sales price and best price. Penalties may apply in some cases when such metrics are not submitted accurately and timely. Further, these 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. It is difficult to predict how Medicare coverage and reimbursement policies will be applied to Dicerna’s 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.

In order to distribute products commercially, we must comply with state laws that require the registration of manufacturers and wholesale distributors of drug and biological products in a state, including, in certain states, manufacturers and distributors who ship products into the state even if such manufacturers or distributors have no place of business within the state. Some states also impose requirements on manufacturers and distributors to establish the pedigree of product in the chain of distribution, including some states that require manufacturers and others to adopt new technology capable of tracking and tracing product as it moves through the distribution chain. Several states have enacted legislation requiring pharmaceutical and biotechnology companies to establish marketing compliance programs, file periodic reports with the state, make periodic public disclosures on sales, marketing, pricing, clinical trials and other activities, and/or register their sales representatives, as well as to prohibit pharmacies and other healthcare entities from providing certain physician prescribing data to pharmaceutical and biotechnology companies for use in sales and marketing, and to prohibit certain other sales and marketing practices. All of our activities are potentially subject to federal and state consumer protection and unfair competition laws.

If our operations are found to be in violation of any of the federal and state healthcare laws described above or any other governmental regulations that apply to us, we may be subject to penalties, including, without limitation, civil, criminal, and/or administrative penalties, damages, fines, disgorgement, exclusion from participation in government programs, such as Medicare and Medicaid, injunctions, private "qui tam" actions brought by individual whistleblowers in the name of the government, or refusal to allow us to enter into government contracts, contractual damages, reputational harm, administrative burdens, diminished profits and future earnings, and the curtailment or restructuring of our operations, any of which could adversely affect our ability to operate our business and our results of operations.

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. 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.

The U.S. federal budget remains in flux, which could, among other things, cut Medicare payments to providers. 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 are an "emerging growth company" and a "smaller reporting company," and we cannot be certain if the reduced reporting requirements applicable to emerging growth companies and smaller reporting companies will make our common stock less attractive to investors.

We are an "emerging growth company" as defined in the Jumpstart Our Business Startups Act ("JOBS Act"). For as long as we continue to be an emerging growth company, we may take advantage of exemptions from various reporting requirements that are applicable to other public companies that are not emerging growth companies, including (1) not being required to comply with the auditor attestation requirements of Section 404(b) of the Sarbanes-Oxley Act of 2002 ("Sarbanes-Oxley Act"), (2) reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements, and (3) exemptions from the requirements of holding a nonbinding advisory vote on executive compensation and stockholder approval of any golden parachute payments not previously approved. We could be an emerging growth company for up to five years, although circumstances could cause us to lose that status earlier, including if the market value of our common stock held by non-affiliates exceeds $700.0 million as of the prior June 30 or if we have total annual gross revenue of $1.07 billion or more during any fiscal year before that time, in which cases we would no longer be an emerging growth company as of the following December 31, or if we issue more than $1.0 billion in non-convertible debt during any three-year period before that time, in which case we would no longer be an emerging growth company immediately. Even after we no longer qualify as an emerging growth company, we may, under certain circumstances, still qualify as a "smaller reporting company," which would allow us to take advantage of many of the same exemptions from disclosure requirements, including not being required to comply with the auditor attestation requirements of Section 404(b) of the Sarbanes-Oxley Act and reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements. We cannot predict if investors will find our common stock less attractive because we may rely on these exemptions. If some investors find our common stock less attractive as a result, there may be a less active trading market for our common stock and our share price may be more volatile.

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 March 4, 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 collaborator, 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 process, 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' 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, 2018, 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 53% 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 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 particularly after we are no longer an emerging growth company and when we cease to be a smaller reporting company, we will continue to incur significant legal, accounting, and other expenses that we did not incur as an emerging growth company or smaller reporting company.

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.

We are not currently required to comply with the rules of the SEC that implement Section 404(b) of the Sarbanes-Oxley Act. Pursuant to Section 404 of the Sarbanes-Oxley Act ("Section 404"), we are required to furnish a report by our management on our internal control over financial reporting. However, while we remain an emerging growth company and a smaller reporting company, we will not be required to include an attestation report on internal control over financial reporting issued by our independent registered public accounting firm. To achieve compliance with Section 404 within the prescribed period, we will be engaged in a process to document and evaluate our internal control over financial reporting, which is both costly and challenging. In this regard, we will need to continue to dedicate internal resources, potentially engage outside consultants, and adopt 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 control over financial reporting. Despite our efforts, there is a risk that we will not be able to conclude, within the prescribed timeframe or at all, that our internal control over financial reporting is effective as required by Section 404. 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 capital 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 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 the purchase of our common stock. As of March 4, 2019, we also had 3,733,792 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 11,206,340 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 March 4, 2019, we had 68,264,949 shares of common stock outstanding, all of which, other than shares held by our collaboration partners, Alexion and Lilly, which are subject to certain lock-up provisions, and 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, and 5,414,185 shares of our common stock to Lilly in December 2018. 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 and Lilly 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 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

Our corporate headquarters are located in Cambridge, Massachusetts, where we lease 37,084 square feet of office and laboratory space. The lease term for our office and laboratory space in Cambridge, Massachusetts, commenced in December 2014 for a lease term of six years.

On January 2, 2019, we entered into a seven-year term lease for 80,872 square feet of office and laboratory space located in Lexington, Massachusetts ("Lexington"). The location in Lexington will become the Company's corporate headquarters upon occupancy, currently anticipated to occur in the fourth quarter of 2019.

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 and expenses directly, which could be substantial.

Settlement of Alnylam Litigation

On June 10, 2015, Alnylam Pharmaceuticals, Inc. ("Alnylam") filed a trade secret misappropriation lawsuit against us in the Superior Court of Middlesex County, Massachusetts seeking to enjoin Dicerna from the use of what they perceived as proprietary and trade secret information related to ribonucleic acid interference assets that Alnylam had purchased from Merck. The suit sought permanent injunctive relief and monetary damages from us. In August 2017, we filed counterclaims in a trade secret lawsuit alleging that the Alnylam actions represented abuse of process and claimed tortious interference with our business opportunities. In September 2017, Alnylam filed a motion to dismiss Dicerna's counterclaims and the motion was denied. In August 2017, we filed a lawsuit against Alnylam in the United States District Court of Massachusetts charging a monopolization violation of the Sherman Antitrust Act. In October 2017, Alnylam filed a motion to dismiss the antitrust lawsuit which was denied.

On April 18, 2018, the parties executed a Settlement & Release Agreement ("Settlement Agreement") resolving all ongoing litigation between the companies. The terms of the Settlement Agreement include mutual releases and dismissal with prejudice of all claims and counterclaims in the following litigation between the parties: (i) *Alnylam Pharmaceuticals, Inc. v. Dicerna Pharmaceuticals, Inc.*, No. 15-4126, pending in the Massachusetts Superior Court for Middlesex County; and, (ii) *Dicerna Pharmaceuticals, Inc. v. Alnylam Pharmaceuticals, Inc.*, pending in the United States District Court for the District of Massachusetts.

Under the terms of the Settlement Agreement, Dicerna paid an aggregate of $25.3 million including an upfront cash payment of $2.0 million and 983,208 shares of Dicerna common stock, valued at $10.3 million, that were initially received by Alnylam in the second quarter of 2018, with an additional $2.5 million paid in November 2018, and the final payment of $10.5 million paid in January 2019. In addition, Dicerna will be subject to time limitations on the development of certain gene targets for period ranging from 18 months up to four years. The Settlement Agreement does not provide any admission of wrongdoing by either company and does not provide any intellectual property licenses to either party.

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." The following table sets forth the high and low sale prices per share for our common stock on The Nasdaq Global Select Market for the periods indicated:

Year Ended December 31, 2018	High	Low
First Quarter	$ 15.00	$ 8.16
Second Quarter	$ 15.80	$ 8.71
Third Quarter	$ 17.98	$ 11.66
Fourth Quarter	$ 16.06	$ 9.31

Year Ended December 31, 2017	High	Low
First Quarter	$ 3.40	$ 2.42
Second Quarter	$ 3.85	$ 2.87
Third Quarter	$ 5.82	$ 2.69
Fourth Quarter	$ 10.24	$ 4.91

Holders of Record

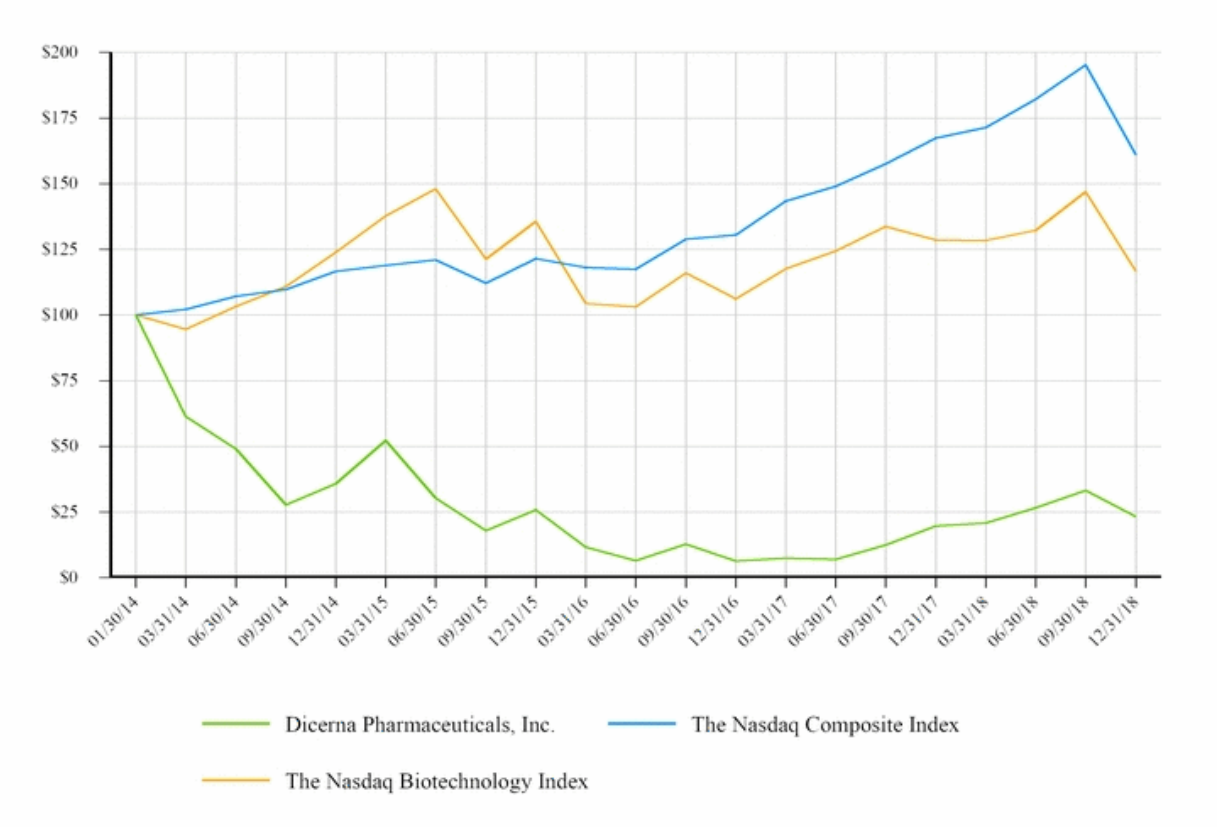
As of March 4, 2019, there were approximately 17 holders of record of our common stock. Because many of our shares of common stock are held by brokers and other institutions on behalf of stockholders, we are unable to estimate the total number of beneficial stockholders represented by these record holders.

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 since January 30, 2014 (the date our stock became publicly traded on The Nasdaq Global Select Market) to The Nasdaq Composite and The Nasdaq Biotechnology indices. The graph assumes an initial investment of $100 on January 30, 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

Not applicable.

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. Our audited consolidated financial statements as of December 31, 2018 and 2017 and for the fiscal years ended December 31, 2018, 2017, and 2016 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,				
	2018	2017 [a]	2016	2015	2014
Results of operations data					
Revenue from collaborative arrangements [b]	$ 6,176	$ 1,030	$ —	$ —	$ —
Net loss	$ (88,853)	$ (60,200)	$ (59,513)	$ (62,839)	$ (47,939)
Net loss attributable to common stockholders	$ (88,853)	$ (80,292)	$ (59,513)	$ (62,839)	$ (48,143)
Net loss per share attributable to common stockholders – basic and diluted	$ (1.60)	$ (3.66)	$ (2.87)	$ (3.09)	$ (3.00)
Weighted average common shares outstanding – basic and diluted	55,616,092	21,917,415	20,719,761	20,320,628	16,070,054

[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 grant revenues 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 current year's presentation.

	DECEMBER 31,				
	2018	2017 [a]	2016	2015	2014
Financial condition data					
Cash and cash equivalents	$ 54,239	$ 68,789	$ 20,865	$ 56,058	$ 26,067
Held-to-maturity investments	$ 248,387	$ 44,889	$ 25,009	$ 38,551	$ 72,556
Total assets	$ 409,041	$ 121,002	$ 51,252	$ 100,023	$ 103,605
Total noncurrent liabilities	$ 114,293	$ 3,090	$ —	$ —	$ —
Total stockholders' equity	$ 200,693	$ 101,086	$ 41,208	$ 91,022	$ 98,340

[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 focused on the discovery and development of innovative subcutaneously delivered ribonucleic acid ("RNA") interference ("RNAi")-based therapeutics using our GalXC™ RNAi platform for the treatment of diseases involving the liver, including rare diseases, viral infectious diseases, chronic liver diseases, and cardiovascular diseases. Within these therapeutic areas, we believe our GalXC RNAi platform will allow us to build a broad pipeline of therapeutics with attractive pharmaceutical properties, including a subcutaneous route of administration, infrequent dosing (e.g., dosing that is monthly or quarterly, and potentially even less frequent), high therapeutic index, and specificity to a single target gene. Our key development programs include DCR-PHXC for the treatment of primary hyperoxaluria ("PH"), currently in a Phase 1 clinical trial with expected initiation of registration studies in the first quarter of 2019; DCR-HBVS for the treatment of chronic hepatitis B virus ("HBV"), currently in a Phase 1 clinical trial; and an undisclosed product candidate against a serious rare liver disease, currently in Clinical Trial Application ("CTA") or Investigational New Drug application ("IND") enabling studies. Dicerna intends to discover, develop, and commercialize novel therapeutics either on its own or in collaboration with pharmaceutical partners. Dicerna has strategic collaborations with 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 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, subject to the evaluation of potential licensing opportunities as they may arise, and to invest internally in diseases with focused patient populations, such as certain rare diseases. We see such diseases as representing opportunities that 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 programs. For more complex diseases with multiple gene dysfunctions and larger patient populations, we plan to pursue collaborations that can provide the enhanced scale, resources, and commercial infrastructure required to maximize these prospects, such as our existing collaborative research and license agreements.

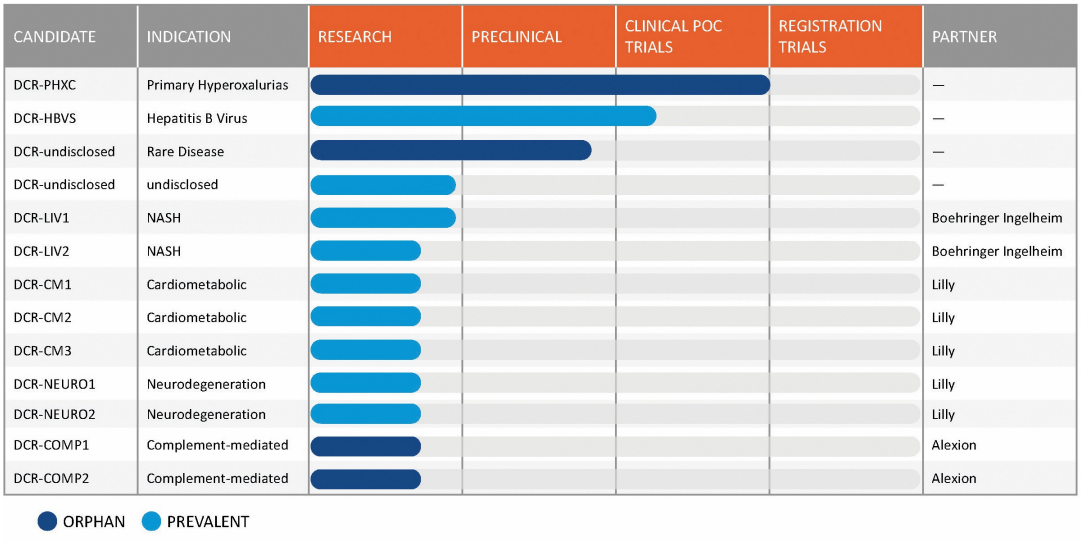
We view our operations and manage our business as one segment, which is the discovery, research, and development of treatments based on our RNAi technology platform.

Development Programs

In choosing which development programs to internally advance, we apply scientific, clinical, and commercial criteria that we believe allow us to best leverage our GalXC RNAi platform and maximize value. We are focusing our efforts on three priority therapeutic programs that currently have a CTA filed, IND filed, or are in enabling studies in preparation to submit additional regulatory applications that will be necessary to initiate clinical trials. We are also focusing our efforts on a series of potential programs in the clinical candidate selection stage, or for which a provisional clinical candidate has been selected that may be elevated into IND/CTA enabling studies in the future, either on our own or in collaboration with larger pharmaceutical companies.

Our three priority programs are: DCR-PHXC for the treatment of PH; DCR-HBVS for the treatment of chronic HBV infection; and a program for an undisclosed rare liver disease. Our potential programs include additional rare disease programs, a program for the treatment of hypercholesterolemia, and multiple programs in various therapeutic areas involving liver function.

The table below sets forth the state of development of our various GalXC RNAi platform product candidates as of March 4, 2019:



Status of Dicerna Programs

Our current GalXC RNAi platform development programs are as follows:

- **Primary Hyperoxaluria.** We are developing DCR-PHXC for the treatment of all types of PH. PH is a family of rare, inborn errors of metabolism in which the liver produces excessive levels of oxalate, which in turn causes damage to the kidneys and other tissues in the body.

  Our Phase 1 clinical trial of DCR-PHXC called PHYOX has completed dosing. In non-clinical models of PH, DCR-PHXC reduces oxalate production to near-normal levels, improving the disease condition. PHYOX is a Phase 1 single ascending-dose study of DCR-PHXC in healthy volunteers ("HVs") and study participants with PH. The study is divided into two groups:

  - Group A is a placebo-controlled, single-blind, single center study which has enrolled 25 HVs.
  - Group B is an open-label, multi-center study enrolling up to 18 participants with PH type 1 ("PH1") or PH type 2 ("PH2"). The primary objective of the study is to evaluate the safety and tolerability of single of DCR-PHXC in both groups. The secondary objectives are to evaluate the pharmacodynamic effect of single doses of DCR-PHXC on biochemical markers, and to characterize the pharmacokinetics of single doses of DCR-PHXC in HVs and study participants with PH.

  In May 2018, we dosed the first PH study participant with DCR-PHXC in the Group B portion of the Phase 1 clinical trial and received notice from the United States ("U.S.") Food and Drug Administration ("FDA") granting Orphan Drug Designation to DCR-PHXC for treatment of PH. In August 2018, the European Medicines Agency's Committee for Orphan Medicinal Products ("COMP") designated DCR-PHXC as an orphan medicinal product for the treatment of PH in the European Union ("EU"). Currently, we are in the process of submitting requests for additional regulatory clearances necessary to commence clinical trials for our Phase 2 and Phase 3 studies in 2019. Key regulatory interactions with the FDA and EMA, in anticipation of Phase 2 and Phase 3 studies, are also underway.

  We have completed the Group A portion of the study in HVs and started the Group B portion of the study. Group B consists of participants with PH1 dosed at 1.5, 3.0, and 6.0-mg/kg, and participants with PH2 at a dose level of 1.5 and 3.0-mg/kg. As of January 17, 2019, we had dosed all 18 participants (15 PH1 participants and three PH2 participants). We reported interim results from the PHYOX trial on September 5, 2018 and presented updated results (as of October 1, 2018) at Kidney Week in San Diego on October 25, 2018.

  As of November 2018, three serious adverse events ("SAEs") have occurred in two participants (one subject experienced two discreet SAEs) in the PHYOX trial; none of these SAEs are related to the study intervention. There have been no clinically significant changes in electrocardiography ("ECG"), vital signs, laboratory, or hematology values. The

investigators have observed in a total of 32 participants dosed (Group A and B together) mild-to-moderate injection site reactions in nine participants (28%), all of which were transient and resolved without intervention within 24 to 72 hours.

As of a data cut on October 1, 2018, investigators reported that a single 3.0-mg/kg dose of DCR-PHXC brought urinary oxalate levels into the normal range (defined as 24-hour excretion <0.460 mmol) at one or more post-dose time points in three out of four PH participants dosed at this level, including a mean maximal reduction in 24-hour urinary oxalate of 65% for the cohort, and a single 1.5-mg/kg dose led to near-normalization (defined as 24-hour excretion ≥0.460 to <0.600 mmol) in three out of four PH1 participants dosed at this level and led to a mean maximal reduction in urinary oxalate of 50% in the five PH patients dosed at that level, including one PH2 patient.

Additionally, we intend to initiate a multi-dose study, which we hope will serve as a registration trial, in the first quarter of 2019, pending regulatory feedback.

- **Chronic Hepatitis B Virus infection.** We have declared a GalXC RNAi platform-based product candidate for the treatment of chronic HBV, DCR-HBVS, and have initiated a Phase 1 clinical trial. We received CTA approval from the New Zealand Medicines and Medical Devices Safety Authority in November 2018 and ethics approval from the Health and Disability Ethics Committee in December 2018 for a Phase 1 clinical trial in HVs and patients with chronic HBV. The Phase 1 study was initiated in December 2018 and the first participants were dosed on January 24, 2019. We anticipate human POC data to be available in the fourth quarter of 2019. In addition, we filed for regulatory clearance in Australia, Hong Kong, South Korea, and Thailand in December 2018.

  Current therapies for HBV rarely lead to a long-term immunological cure as measured by the clearance of HBV surface antigen ("HBsAg") and sustained HBV deoxyribonucleic acid ("DNA") suppression in patient plasma or blood. DCR-HBVS targets HBV mRNA and leads to greater than 99% reduction in circulated HBsAg in mouse models of HBV infection. DCR-HBVS is comprised of a single GalXC molecule that targets HBV mRNAs within the HBsAg gene sequence region. In preclinical studies with a standard mouse model of HBV infection, we have found that targeting this region leads to superior HBsAg suppression, both in magnitude and duration of suppression, compared to targeting within the X gene sequence region. We believe that this difference in suppression derives from the role of the X gene product in indirectly regulating viral gene transcription such that the lack of X gene product leads to higher levels of viral gene transcription. Based on our preclinical studies, we hope to determine the potential of DCR-HBVS to reduce HBsAg and HBV DNA levels in the blood of HBV patients in a commercially attractive subcutaneous dosing paradigm.

- **An undisclosed rare disease involving the liver.** We are developing a GalXC-based therapeutic, targeting a liver-expressed gene involved in a serious rare disease. For competitive reasons, we have not yet publicly disclosed the target gene or disease. The disease is a genetic disorder where mutations in the disease gene lead to the production of an abnormal protein. The protein causes progressive liver damage and fibrosis, in some cases leading to cirrhosis and liver failure, and we believe that silencing of the disease gene will prevent production of the abnormal protein and thereby slow or stop progression of the liver fibrosis. We intend to submit regulatory filings in the second quarter of 2019.

- **Additional pipeline programs.** We have developed a robust portfolio of additional targets and diseases that we plan to pursue either on our own or in collaboration with partners. We have applied our GalXC technology to multiple gene targets across our disease focus areas of rare diseases, chronic liver diseases, and cardiovascular diseases.

  Pursuant to our strategy, we are seeking collaborations with larger and/or more experienced pharmaceutical companies to advance our programs in the areas of chronic liver diseases and cardiovascular diseases, as well as select rare diseases that do not fit our criteria for a priority development program. The chronic liver and cardiovascular disease areas represent large and diverse patient populations, requiring complex clinical development and commercialization paths that we believe can be more effectively pursued in collaboration with larger pharmaceutical companies. Certain rare diseases require complex clinical development and commercialization paths aligned with existing treatment paradigms that we believe can be more effectively pursued in collaboration with companies possessing certain rare disease expertise.

  For our additional rare disease opportunities, we are continuing to assess their potential for clinical success and market opportunity while optimizing our GalXC molecules. For our additional pipeline programs, we may utilize more advanced versions of our GalXC technology that further improve pharmaceutical properties of the GalXC molecules, including enhancing the duration of action and potency. We have further optimized our GalXC technology platform, enabling the development of next generation GalXC molecules. Improvements to our GalXC compound include modification of the tetraloop end of the molecule, which can be applied to any target gene, resulting in a substantially longer duration of action and higher potency of target gene silencing in animal models across multiple targets. Modification of the tetraloop only impacts the sense strand and does not impact the antisense strand. These modifications are unique to our GalXC molecules and, we believe, provide a competitive advantage for the Company.

Partner Development Programs

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 (i.e., non-hepatocyte) 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, non-creditable upfront payment of $100.0 million, and made a concurrent stated $100.0 million equity investment in us 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. Through December 31, 2018, no revenue has been recognized associated with the Lilly Collaboration Agreement.

Alexion Collaboration

On October 22, 2018, we and Alexion entered into a Collaborative Research and License Agreement (the "Alexion Collaboration Agreement") 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 subcutaneously delivered GalXC candidates, currently in preclinical development, 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 through the completion of Phase 1, the costs of which 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 also provides Alexion with exclusive worldwide licenses as well as development and commercial rights for two of our preclinical, subcutaneously delivered GalXC RNAi candidates and an exclusive option for the discovery and development of GalXC RNAi candidates against two additional complement pathway targets.

Under the terms of the Alexion Collaboration Agreement, Alexion paid us a non-refundable, non-reimbursable, and non-creditable upfront payment of $22.0 million, with Alexion Pharmaceuticals making a concurrent stated $15.0 million equity investment at a premium in Dicerna 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 is comprised of option exercise fees of up to $20.0 million, representing $10.0 million for each of the 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. Through December 31, 2018, we recognized $0.1 million in revenue associated with the Alexion Collaboration Agreement.

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 an initial undisclosed target gene and includes an option for BI to add the development of product candidates that target a second gene (the "Additional Target"). We are working exclusively with BI to develop the product candidates against the undisclosed target gene. We are responsible for the discovery and initial profiling of the product candidates, including primary preclinical studies, synthesis, and delivery. 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 on potential global net sales, subject to certain adjustments, tiered from high single digits up to low double-digits.

In October 2018, BI exercised its option under the BI Agreement to add the development of product candidates targeting an Additional Target to the development activities governed by the BI Agreement. On December 31, 2018, we entered into an Additional Target Agreement (the "ATA") with BI. The ATA requires the parties to agree on a research work plan and budget for the Additional Target. The ATA also amends the BI Agreement to provide BI with the option to add the development of product candidates targeting a further additional undisclosed gene target to the BI Agreement (the "Second Target" option) for a three-year period, and to provide for the delivery of a replacement product candidate by us to BI in the event that a product candidate under the BI Agreement or the ATA fails at certain stages of preclinical or clinical development.

Under the terms of the ATA, in accordance with the terms of the BI Agreement, BI agreed to pay us a non-refundable upfront payment of $5.0 million to exercise its initial option for development related to the Additional Target. 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 Additional 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 Additional Target will be subject to the terms of the BI Agreement. Under the ATA, if BI elects to exercise the second option, the parties would agree to a research work plan and budget for the additional gene and negotiate development and commercialization milestones and royalty payments to Dicerna. BI would make another option fee payment to us of $5.0 million. Through December 31, 2018, we have recognized $7.1 million in revenue associated with the BI Agreement.

Other Development Programs

We have also developed a wholly-owned clinical candidate, DCR-BCAT, targeting the ß-catenin oncogene. DCR-BCAT is based on an extended version of our earlier generation non-GalXC RNAi technology and is delivered by our lipid nanoparticle ("LNP") tumor delivery system, EnCore™. We plan to out-license the DCR-BCAT opportunity, given our focus on our GalXC platform-based programs.

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, 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.

Options: Customer options, such as options granted to allow a licensee to choose to research and develop product candidates against target genes to be identified in the future, generally do not provide a material right to the customer and therefore do not give

rise to a separate performance obligation. 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, additional option fee payments are recognized or begin being recognized as revenue when the licensee exercises the options, and the exercise of the option would be 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 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 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.

Not yet adopted

Leases

In February 2016, accounting guidance related to leases was issued that will require an entity to recognize leased assets and the rights and obligations created by those leased assets on the balance sheet and to disclose key information about an entity's leasing arrangements. This guidance became effective for us on January 1, 2019. We expect that the adoption of this guidance will impact our consolidated financial statements and notes thereto, largely resulting from the recognition of right of use assets and related liabilities related to our non-cancelable operating lease arrangements for office and laboratory spaces. The Company is in the process of determining whether it will utilize the optional transition method presented in the new guidance.

As of December 31, 2018, and as presented in Note 14 – Commitments and Contingencies to our consolidated financial statements (see Part I, Item 8 – "Financial Statements and Supplementary Data" of this Annual Report on Form 10-K), our total future minimum lease obligation associated with our Cambridge, MA lease was $3.3 million, which will remain outstanding at the time we adopt the new guidance.

Recent Developments

Lexington lease

On January 2, 2019, we entered into a non-cancelable real property lease agreement with Hayden Office Trust under a Declaration of Trust dated August 24, 1977, as the same may have been amended, for approximately 80,872 square feet of laboratory and office space in Lexington, Massachusetts (the "Lexington Lease"). We intend to move our corporate headquarters and research facility to this location upon occupancy, which is expected to occur in the fourth quarter of 2019.

The original term (the "Original Term") of the Lexington Lease is seven years, commencing on the earlier of (a) the date on which the premises are ready for occupancy under the terms of the lease, or (b) the date on which we commence occupancy of any

portion of the premises for the permitted uses under the lease. 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.

Cambridge sublease

On January 4, 2019, we entered into a non-cancelable real property sublease agreement with PPF OFF 150 Cambridge Park Drive, LLC (the "Landlord") and International Business Machines Corporation (the "Sublandlord"), 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.

Alnylam Settlement Agreement

On April 18, 2018, we entered into a Confidential Settlement Agreement and General Release (the "Settlement Agreement") with Alnylam Pharmaceuticals, Inc. ("Alnylam"), resolving all ongoing litigation between us and Alnylam. The terms of the Settlement Agreement include mutual releases and dismissals with prejudice of all claims and counterclaims in the following litigation between the parties: (i) Alnylam Pharmaceuticals, Inc. v. Dicerna Pharmaceuticals, Inc., No. 15-4126 pending in the Massachusetts Superior Court for Middlesex County and (ii) Dicerna Pharmaceuticals, Inc., v. Alnylam Pharmaceuticals, Inc. No.1:17-cv-11466 pending in the United States District Court for the District of Massachusetts. Under the terms of the Settlement Agreement, in the second quarter of 2018, we paid Alnylam an upfront cash payment of $2.0 million and issued 983,208 shares of Dicerna common stock, which was valued at $10.3 million based on the closing price of our common stock on the date the Settlement Agreement was executed, $2.5 million paid in November 2018, and a final payment of $10.5 million in January 2019. The issuance of shares of our common stock were pursuant to a share issuance agreement between the parties.

Under the Settlement Agreement, for periods ranging from 18 months up to four years, we will be restricted in our 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 our 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 other intellectual property from either party.

As a result of the recently executed partnership agreement with Lilly, we expected that our remaining obligation as of December 31, 2018 would become due. As a result, we recalculated the cash obligation to an estimated present value of $10.5 million based on the expected timing of the remaining payments and recorded it in current liabilities as of December 31, 2018.

Financial Operations Overview

Executive Overview

Our results of operations and liquidity and capital resources for and as of the year ended December 31, 2018, compared to the prior year, reflect the following:

- In April 2018, we entered into the Settlement Agreement with Alnylam, resolving all ongoing litigation between the two companies. Pursuant to the terms of the Settlement Agreement, Dicerna paid to Alnylam an upfront payment of $2.0 million, agreed to a future payment of $13.0 million (of which $2.5 million was paid in November 2018 and $10.5 million was paid in January 2019), and issued 983,208 shares of Dicerna common stock worth $10.3 million to Alnylam.

- On September 6, 2018, we entered into an underwriting agreement with Citigroup Global Markets Inc. and Leerink Partners LLC as representatives of the underwriters relating to the underwritten public offering of 7,680,492 shares of our common stock, and the grant to the underwriters of a 30-day option to purchase up to an additional 1,152,073 shares of our common stock. We completed the sale of 8,832,565 shares to the underwriters on September 11, 2018, which resulted in net proceeds to us of approximately $107.7 million, after deducting underwriting discounts and commissions and estimated offering expenses payable by us.
- In October 2018, we entered into the Alexion Collaboration Agreement for the joint discovery and development of RNAi therapies for complement-mediated diseases. Under the terms of the agreement, we received an upfront payment of $22.0 million, with Alexion making a concurrent stated $15.0 million equity investment at a premium in the Company.
- In October 2018, we entered into the Lilly Collaboration Agreement for the discovery, development, and commercialization of potential new medicines in the areas of cardiometabolic disease, neurodegeneration, and pain. Under the terms of the agreement, we received an upfront payment of $100.0 million in January 2019, and, in December 2018, Lilly made a stated $100.0 million equity investment at a premium in the Company.
- In October 2018, BI exercised its Second Target option, which entitled the Company to a non-refundable payment of $5.0 million upon the agreement of a research work plan and budget, which were finalized in January 2019. The terms of the Second Target option exercise and related rights and obligations associated with the Second Target were agreed upon through an Additional Target Agreement ("ATA") that was executed with BI on December 31, 2018. Since the Second Target option was not considered to be a material right, the exercise of the Second Target option is being treated as a separate contract for accounting purposes.

Revenue from collaborative arrangements

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 for the foreseeable 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. If we, our current collaboration partners, or any future collaborator fails to develop product candidates in a timely manner or obtain regulatory approval for them, our ability to generate future revenue from collaboration arrangements, and our results of operations and financial position, would be materially and adversely affected.

Lilly Collaboration and License Agreement

On October 25, 2018, we entered into the Lilly Collaboration Agreement, pursuant to which we were entitled to receive a non-refundable, non-creditable upfront payment of $100.0 million and a concurrent stated $100.0 million equity investment at a premium pursuant to a share issuance agreement between the parties (the "Lilly Share Issuance Agreement"). At December 31, 2018, the non-refundable, non-creditable upfront payment of $100.0 million was recorded as a contract receivable in the accompanying consolidated balance sheets. During the year ended December 31, 2018, we did not recognize any revenue associated with the Lilly Collaboration 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. Lilly may terminate the Lilly Collaboration Agreement at any time without cause following a 90-day notice period.

Alexion Collaborative Research and License Agreement

On October 22, 2018, we entered into the Alexion Collaboration Agreement, pursuant to which we received a non-refundable, non-reimbursable, and non-creditable upfront payment of $22.0 million and a concurrent stated $15.0 million equity investment at a premium pursuant to a share issuance agreement between the parties (the "Alexion Share Issuance Agreement"). Alexion made both

payments during the fourth quarter of 2018. During the year ended December 31, 2018, we recognized $0.1 million in revenue associated with the Alexion Collaboration Agreement.

The Alexion Collaboration Agreement also provides for potential additional payments of up to $600.0 million, from proceeds from target option exercises and development and sales milestones, as defined in the agreement, which is comprised of option exercise fees of up to $20.0 million, representing $10.0 million for each of the 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.

BI Agreements

On October 27, 2017, we entered into the BI Agreement, as discussed above, pursuant to which we were entitled to receive a non-refundable upfront payment of $10.0 million, less a refundable withholding tax in Germany of $1.6 million. BI paid us $8.4 million during the fourth quarter of 2017. The non-refundable upfront payment was subject to a German withholding tax, which was withheld by BI and remitted to the German tax authority in accordance with local tax law. We collected the remaining $1.6 million during 2018. During the years ended December 31, 2018 and 2017, we recognized $6.1 million and $1.0 million, respectively, in revenue associated with the BI Agreement, including reimbursable third-party research expenses that are billable to BI.

The deliverables at the effective date of the BI Agreement include delivery of intellectual property, conducting agreed-upon research program services, and providing BI the exclusive option right to reserve additional targets. We concluded that the performance of additional research for any additional target, if the underlying target option is exercised by BI, is not a deliverable of the agreement at inception because it is a substantive option and is not priced at a significant and incremental discount. Milestone payments that are contingent upon our performance under the BI Agreement include developmental milestones, as defined in the agreement, totaling $99.0 million. We view these milestones as substantive and have excluded the amounts from allocable consideration at the outset of the arrangement. All potential commercial milestones, as defined in the agreement, totaling $95.0 million, will be accounted for in the same manner as royalties and recorded as revenue upon achievement of the applicable milestone, assuming all other revenue recognition criteria are met.

In October 2018, BI exercised their option under the BI Agreement to add the development of product candidates targeting an additional gene (the "Additional Target") to the development activities governed by the BI Agreement. On December 31, 2018, we entered into an Additional Target Agreement (the "ATA") with BI. The ATA requires the parties to agree on a research work plan and budget for the Additional Target, which was completed in January 2019, at which point BI paid us a $5.0 million option exercise fee. The ATA also amends the BI Agreement to provide BI with the option to add the development of product candidates targeting a further additional undisclosed gene for a three-year period, and to provide for the delivery of a replacement product candidate by us to BI in the event that a product candidate under the BI Agreement or the ATA fails at certain stages of preclinical or clinical development.

Under 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 Additional 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 Additional Target will be subject to the terms of the BI Agreement. Under the ATA, if BI elects, in their sole discretion, to exercise their option to add the development of product candidates targeting a further additional undisclosed gene, the parties would agree to a research work plan and budget for the additional gene and negotiate development and commercialization milestones and royalty payments to us. BI would make another option fee payment to us of $5.0 million.

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.

The process of conducting preclinical studies and clinical trials necessary to obtain regulatory approval is costly and time-consuming. We or any of our current or future collaborators may never succeed in obtaining marketing approval for any of our product candidates. The probability of success for each product candidate may be affected by numerous factors, including preclinical data, clinical data, competition, manufacturing capability, and commercial viability. All of our research and development programs are at an early stage, and successful development of future product candidates from these programs is highly uncertain and may not result in approved products. Completion dates and completion costs can vary significantly for each future product candidate and are difficult to predict. We anticipate we will make determinations as to which product candidates to pursue and how much funding to direct to each product candidate on an ongoing basis in response to our ability to maintain or enter into collaborations with respect to each product candidate, the scientific and clinical success of each product candidate, as well as ongoing assessments as to the commercial potential of product candidates. We will need to raise additional capital and may seek additional collaborations in the future in order to advance our various product candidates. Additional private or public financings may not be available to us on acceptable terms, or at all. Our failure to raise capital as and when needed would have a material adverse effect on our financial condition and our ability to pursue our business strategy.

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, and support functions. Other general and administrative expenses include travel expenses, professional fees for legal (excluding settlement and litigation expenses related to the Alnylam Settlement), 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 and the Settlement Agreement.

Interest income

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

Interest expense

Interest expense represents the accretion of the net present value of the litigation settlement payable to its carrying value.

Results of Operations

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 from collaborative arrangements	$ 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 from collaborative arrangements

During the year ended December 31, 2018, revenue from collaborative arrangements 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. As of December 31, 2018, we expect to recognize the remaining $3.2 million of the non-refundable upfront payment on a straight-line basis through August 2019.

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 expect to recognize this amount over the remaining research program term, which we estimate will extend through the fourth quarter of 2023.

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,			
	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 DCR-PHXC and $1.1 million for DCR-HBVS. 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.

We expect our overall research and development expenses to increase in 2019 and for the foreseeable future, primarily as we complete clinical manufacturing activities, advance preclinical toxicology studies, continue clinical activities associated with our lead product candidates, and as our development efforts continue to increase related to progress made in connection with our collaboration agreements.

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.

We expect general and administrative expenses to continue to increase in 2019, largely due to planned investment in staffing, preparation of our new company headquarters, and market readiness activities.

Litigation expense

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.

Comparison of the years ended December 31, 2017 and 2016

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

	YEAR ENDED DECEMBER 31,			
	2017	2016	$ CHANGE	% CHANGE
Revenue from collaborative arrangements	$ 1,030	$ —	$ 1,030	— %
Operating expenses:				
Research and development	35,888	41,399	(5,511)	(13.3)%
General and administrative	16,838	15,433	1,405	9.1 %
Litigation expense	9,043	2,916	6,127	210.1 %
Total operating expenses	61,769	59,748	2,021	3.4 %
Loss from operations	(60,739)	(59,748)	(991)	1.7 %
Other income (expense):				
Interest income	539	235	304	129.4 %
Total other income, net	539	235	304	129.4 %
Net loss	(60,200)	(59,513)	(687)	1.2 %
Dividends on redeemable convertible preferred stock	(10,111)	—	(10,111)	— %
Deemed dividend related to beneficial conversion feature of redeemable convertible preferred stock	(6,144)	—	(6,144)	— %
Deemed dividend on conversion of redeemable convertible preferred stock	(3,837)	—	(3,837)	— %
Net loss attributable to common stockholders	$ (80,292)	$ (59,513)	$ (20,779)	34.9 %

Revenue from collaborative arrangements

During the year ended December 31, 2017, we recognized $1.0 million of revenue associated with the BI Agreement. This amount represents partial amortization of the $10.0 million upfront payment received from BI for the first target and $0.3 million in reimbursable costs of certain materials and third-party expenses that have been included in preclinical studies pursuant to the BI Agreement, which was signed in the fourth quarter of 2017. During the year ended December 31, 2017, the upfront payment and reimbursable costs related to the BI Agreement was being recognized ratably over a period of 20 months, which represented our then current estimate for the research term over which the research and development services were to be provided, as well as reimbursable third-party research expenses billable to BI.

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,			
	2017	2016	$ CHANGE	% CHANGE
Direct research and development expenses	$ 15,898	$ 13,603	$ 2,295	16.9 %
Platform-related expenses	6,611	11,302	(4,691)	(41.5)%
Employee-related expenses	10,155	12,972	(2,817)	(21.7)%
Facilities, depreciation, and other expenses	3,224	3,522	(298)	(8.5)%
Total	$ 35,888	$ 41,399	$ (5,511)	(13.3)%

Total research and development expenses decreased by $5.5 million during 2017, compared to 2016, despite an overall increase in direct research and development expenses of $2.3 million, which was due to increased drug substance, toxicology study and manufacturing activities associated with our GalXC platform product candidates. The increase was partially offset by a decrease in comparative clinical activities related to our non-GalXC platform clinical trials, which were discontinued during 2016. Platform-related expenses decreased primarily as a result of lower spending in discovery and early development programs, which advanced in 2017 into manufacturing and clinical testing. Employee-related expenses decreased due to an overall decrease in headcount from 2016, along with a decrease in non-cash stock-based compensation costs.

Total research and development expenses for the years ended December 31, 2017 and 2016 were additionally offset by $1.1 million and $0.3 million of grant income, respectively.

General and administrative expenses

General and administrative expenses were $16.8 million and $15.4 million for the years ended December 31, 2017 and 2016, respectively. The increase of $1.4 million was primarily due to higher salaries, benefits, and other employee-related expenses.

Litigation expenses

Litigation expenses are entirely associated with the litigation with Alnylam. Litigation expenses increased $6.1 million due to higher legal fees associated with the litigation with Alnylam during the year ended December 31, 2017.

Interest income

Interest income is comprised primarily of interest earned from our money market accounts and held-to-maturity investments. Interest income was $0.5 million and $0.2 million for the years ended December 31, 2017 and 2016, respectively. The increase was primarily due to higher invested amounts in 2017 primarily as a result of the receipt of net proceeds from the Private Placement, which closed in April 2017.

Dividends

Non-cash dividends of $10.1 million recorded during the year ended December 31, 2017 represent the fair value of accrued dividends on redeemable convertible preferred shares issued to the preferred holders, as well as full accretion of share issuance costs. The fair value of the dividends on the dividend dates of June 30, 2017 and September 30, 2017 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. Inputs to the lattice model included an adjusted risk rate, our common stock volatility, the underlying common stock price on the dividend date and management's judgment associated with probability simulations of various outcomes. Dividends were valued at each dividend declaration date based on various inputs and assumptions at that time.

The non-cash deemed dividend related to the BCF of the redeemable convertible preferred stock of $6.1 million for the year ended December 31, 2017 represents the value of a BCF which was recorded on the redeemable convertible preferred shares. 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 determined to be the date of issuance. Intrinsic value was calculated as the difference between the effective conversion price and the fair value of our common stock, multiplied by the number of shares into which the issued shares of redeemable convertible preferred were convertible. The BCF which

was accreted in full at issuance due to the fact that the underlying shares of redeemable convertible preferred were immediately convertible, and such accretion was recorded as a deemed dividend.

The non-cash deemed dividend on conversion of redeemable convertible preferred stock of $3.8 million for the year ended December 31, 2017 represents the excess fair value of common stock transferred in the conversion transaction to the Preferred Holders over the fair value of common stock issuable pursuant to the original conversion terms. This excess was recorded as a deemed dividend on conversion of the redeemable convertible preferred stock and has been added to net loss to arrive at net loss attributable to common stockholders in our consolidated statement of operations for the year ended December 31, 2017.

As noted above, all shares of redeemable convertible preferred stock were converted into shares of our common stock on December 18, 2017, and, as such, no additional dividends or deemed dividends will be recorded on the redeemable convertible preferred stock in the future. No common stock dividends were recorded during the years ended December 31, 2017 or 2016.

Net loss attributable to common stockholders

Net loss attributable to common stockholders was $80.3 million and $59.5 million for the years ended December 31, 2017 and 2016, respectively. The overall increase in net loss attributable to common stockholders was due to the recording of dividends in 2017 on the redeemable convertible preferred stock, as well as to the deemed dividends related to the BCF and upon conversion of the redeemable convertible preferred stock, and to higher general and administrative expenses, partially offset by higher collaboration and grant revenues and lower research and development expenses.

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, 2018, we had cash, cash equivalents, and held-to-maturity investments of $302.6 million and $0.7 million in cash equivalents held in restriction. In early 2019, we received an additional $105.0 million in proceeds from the Lilly and BI collaborations, which were offset by the $10.5 million final settlement payment to Alnylam, which became payable upon receipt of the proceeds from Lilly.

On October 31, 2016, a universal shelf registration statement on Form S-3 permitting the sale of up to $150.0 million of our common stock and other securities was declared effective by the U.S. Securities and Exchange Commission ("SEC"). On April 11, 2017, pursuant to an agreement with seven institutional investors (the "Preferred Holders") we issued and sold 700,000 shares of our newly designated redeemable convertible preferred stock to the Preferred Holders in a private placement for aggregate gross proceeds of $70.0 million, less issuance costs of approximately $0.8 million (the "Private Placement"). On December 18, 2017, we completed the conversion of the redeemable convertible preferred stock and issued an aggregate of 24,206,663 shares of our common stock pursuant to this registration statement, after which no shares of redeemable convertible preferred stock remained outstanding.

On December 18, 2017, we completed an underwritten follow-on public offering and sale of 6,571,428 shares which resulted in the receipt of aggregate gross proceeds of $46.0 million, less underwriter commissions and additional offering expenses totaling approximately $3.2 million.

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.

In connection with the Alexion Collaboration Agreement, we entered into the Alexion Share Issuance Agreement on October 22, 2018, pursuant to which we agreed to issue to Alexion 835,834 shares of our common stock at a purchase price of $17.95 per share for an aggregate purchase price of approximately $15.0 million.

In connection with the Lilly Collaboration Agreement, we entered into the Lilly Share Issuance Agreement on October 25, 2018, pursuant to which we agreed to issue to Lilly 5,414,185 shares of our common stock at a purchase price of $18.47 per share for an aggregate purchase price of approximately $100.0 million. The shares were issued and the purchase price was received on December 19, 2018.

Cash flows

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

	YEAR ENDED DECEMBER 31,		
	2018	2017	2016
Net cash provided by (used in) operating activities	$ 18,298	$ (45,327)	$ (48,747)
Net cash (used in) provided by investing activities	$ (202,731)	$ (19,852)	$ 13,020
Net cash provided by financing activities	$ 169,883	$ 112,731	$ 534

Operating activities

Net cash provided by (used in) operating activities was $18.3 million and $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.

Net cash used in operating activities was $45.3 million and $48.7 million for the years ended December 31, 2017 and 2016, respectively. The $3.4 million net decrease in cash used in operating activities is due primarily to the receipt of proceeds, net of the refundable German withholding tax, from BI, as discussed above, and lower research and development expenses, partially offset by higher general and administrative expenses and other net working capital fluctuations.

Investing activities

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.

Net cash used in investing activities for the year ended December 31, 2017 was $19.9 million, compared to net cash provided by investing activities of $13.0 million for the year ended December 31, 2016. The increase of $32.9 million in net cash used in investing activities during 2017 relates primarily to higher purchases of held-to-maturity investments, largely following the receipt of net proceeds from the issuance of the redeemable convertible preferred stock, partially offset by higher maturities of held-to-maturity investments.

Financing activities

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.

Net cash provided by financing activities was $112.7 million and $0.5 million for the years ended December 31, 2017 and 2016, respectively. The increase of $112.2 million was principally due to the receipt of $69.3 million in net proceeds from the private placement of the redeemable convertible preferred stock, as well as to the receipt of $43.2 million in net proceeds from the 2017 follow-on offering, partially offset by lower proceeds received in connection with stock option exercises and with common stock issuances under our employee stock purchase plan.

Funding requirements

We expect that our primary uses of capital will continue to be 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 available cash, cash equivalents, and held-to-maturity investments will be sufficient to fund the execution of our current clinical and operating plans beyond the year ending December 31, 2020. We have 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 Lilly Collaboration Agreement, the Alexion Collaboration Agreement, or the BI Agreement;
- 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;
- 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. We may be unable to raise capital or enter into such other arrangements when needed or on favorable terms, or at all. Our failure to raise capital or enter into such other arrangements in a reasonable timeframe would have a negative impact on our financial condition, and we may have to delay, reduce or terminate our research and development programs, preclinical or clinical trials, limit strategic opportunities or undergo reductions in our workforce or other corporate restructuring activities.

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 significant contractual obligations as of December 31, 2018 (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 obligation*	$ 3,259	$ 1,678	$ 1,581	$ —	$ —

* Represents future minimum lease payments under a non-cancelable operating lease for our office and laboratory space in Cambridge, Massachusetts. The end of the lease term is November 30, 2020.

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, 2018.

We had a balance of $10.5 million for the litigation settlement liability related to Alnylam recorded on our consolidated balance sheet as of December 31, 2018, which was paid in full in January 2019 upon receipt of the $100.0 million upfront payment from the Lilly collaboration.

Off-Balance Sheet Arrangements

As of December 31, 2018, 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. Other than the operating lease for our Company headquarters in Cambridge, Massachusetts, we do not engage in off-balance sheet arrangements. Upon adoption of the new lease accounting standard on January 1, 2019, we anticipate that the requirement to capitalize all long-term leases will result in our existing lease, along with any new facility leases, being recorded on our consolidated balance sheet.

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, 2018, we had cash, cash equivalents, and held-to-maturity investments of $302.6 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 would not have a material effect on the fair market value of our cash and cash equivalents or held-to-maturity investments. To minimize the risk in the future, we intend to maintain our portfolio of cash and 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 stockholders and the Board of Directors 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, 2018 and 2017, 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, 2018, 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, 2018 and 2017, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2018, in conformity with accounting principles generally accepted in the United States of America.

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 Public Company Accounting Oversight Board (United States) ("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. The Company is not required to have, nor were we engaged to perform, an audit of its internal control over financial reporting. As part of our audits, we are required to obtain an understanding of internal control over financial reporting but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control over financial reporting. Accordingly, we express no such opinion.

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.

/s/ Deloitte & Touche LLP

Boston, Massachusetts

March 13, 2019

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,	
	2018	2017
ASSETS		
CURRENT ASSETS:		
Cash and cash equivalents	$ 54,239	$ 68,789
Held-to-maturity investments	248,387	44,889
Contract receivables	100,000	—
Withholding tax receivable	—	1,583
Prepaid expenses and other current assets	2,888	3,415
Total current assets	405,514	118,676
NONCURRENT ASSETS:		
Property and equipment, net	2,718	1,512
Restricted cash equivalents	744	744
Other noncurrent assets	65	70
Total noncurrent assets	3,527	2,326
TOTAL ASSETS	$ 409,041	$ 121,002
LIABILITIES AND STOCKHOLDERS' EQUITY		
CURRENT LIABILITIES:		
Accounts payable	$ 5,013	$ 4,920
Accrued expenses and other current liabilities	9,649	5,726
Litigation settlement payable	10,500	—
Current portion of deferred revenue	68,893	6,180
Total current liabilities	94,055	16,826
NONCURRENT LIABILITIES:		
Deferred revenue, net of current portion	114,293	3,090
Total noncurrent liabilities	114,293	3,090
TOTAL LIABILITIES	208,348	19,916
COMMITMENTS AND CONTINGENCIES (NOTE 14)		
STOCKHOLDERS' EQUITY:		
Preferred stock, $0.0001 par value – 5,000,000 shares authorized; no shares issued or outstanding at December 31, 2018 or 2017	—	—
Common stock, $0.0001 par value – 150,000,000 shares authorized; 68,210,742 and 51,644,841 shares issued and outstanding at December 31, 2018 and 2017, respectively	7	5
Additional paid-in capital	605,495	417,037
Accumulated deficit	(404,809)	(315,956)
Total stockholders' equity	200,693	101,086
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY	$ 409,041	$ 121,002

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,		
	2018	2017	2016
Revenue from collaborative arrangements	$ 6,176	$ 1,030	$ —
Operating expenses:			
Research and development	45,711	35,888	41,399
General and administrative	21,685	16,838	15,433
Litigation expense	29,132	9,043	2,916
Total operating expenses	96,528	61,769	59,748
Loss from operations	(90,352)	(60,739)	(59,748)
Other income (expense):			
Interest income	2,102	539	235
Interest expense	(603)	—	—
Total other income, net	1,499	539	235
Net loss	(88,853)	(60,200)	(59,513)
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	$ (88,853)	$ (80,292)	$ (59,513)
Net loss per share attributable to common stockholders – basic and diluted	$ (1.60)	$ (3.66)	$ (2.87)
Weighted average common shares outstanding – basic and diluted	55,616,092	21,917,415	20,719,761

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, 2016	—	$ —	20,594,575	$ 2	$ 287,263	$ (196,243)	$ 91,022
Exercises of common stock options and sales of common stock under Employee Stock Purchase Plan	—	—	152,200	—	561	—	561
Vesting of restricted common stock	—	—	10,000	—	—	—	—
Settlement of restricted stock for tax withholding	—	—	(3,774)	—	(27)	—	(27)
Stock-based compensation expense	—	—	—	—	9,165	—	9,165
Net loss	—	—	—	—	—	(59,513)	(59,513)
BALANCE – December 31, 2016	—	—	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

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,		
	2018	**2017**	**2016**
CASH FLOWS FROM OPERATING ACTIVITIES:			
Net loss	$ (88,853)	$ (60,200)	$ (59,513)
Adjustments to reconcile net loss to net cash used in operating activities:			
Non-cash litigation expense	10,315	—	—
Stock-based compensation expense	7,888	7,770	9,165
Depreciation and amortization expense	774	778	840
Loss on disposal of property and equipment	12	51	—
Amortization of (premium) discount on investments	(1,126)	(169)	73
Changes in operating assets and liabilities:			
Litigation settlement payable	10,500	—	—
Deferred revenue	173,916	9,270	—
Prepaid expenses and other assets	532	(1,459)	(414)
Accounts payable	(1,217)	626	1,644
Contract receivables	(100,000)	—	—
Withholding tax receivable	1,583	(1,583)	—
Accrued expenses and other liabilities	3,974	(411)	(542)
Net cash provided by (used in) operating activities	18,298	(45,327)	(48,747)
CASH FLOWS FROM INVESTING ACTIVITIES:			
Maturities of held-to-maturity investments	81,000	70,000	48,500
Purchases of held-to-maturity investments	(283,372)	(89,719)	(35,031)
Purchases of property and equipment	(359)	(133)	(449)
Net cash (used in) provided by investing activities	(202,731)	(19,852)	13,020
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	(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	60,412	—	—
Proceeds from exercises of common stock warrants, stock options and issuances under Employee Stock Purchase Plan	2,110	290	561
Settlement of restricted stock for tax withholding	(35)	(11)	(27)
Net cash provided by financing activities	169,883	112,731	534
NET (DECREASE) INCREASE IN CASH, CASH EQUIVALENTS, AND RESTRICTED CASH EQUIVALENTS	(14,550)	47,552	(35,193)
CASH, CASH EQUIVALENTS, AND RESTRICTED CASH EQUIVALENTS – Beginning of year	69,533	21,981	57,174
CASH, CASH EQUIVALENTS AND RESTRICTED CASH EQUIVALENTS – End of year	$ 54,983	$ 69,533	$ 21,981
NONCASH INVESTING ACTIVITIES:			
Property and equipment purchases included in accounts payable and accrued expenses	$ 1,648	$ 15	$ 53
NONCASH FINANCING ACTIVITIES:			
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 reported within the consolidated balance sheets that sum to the total of the same such amounts shown in the consolidated statements of cash flows:

	DECEMBER 31,		
	2018	2017	2016
Cash and cash equivalents	$ 54,239	$ 68,789	$ 20,865
Restricted cash equivalents	744	744	1,116
Total cash, cash equivalents, and restricted cash equivalents shown in the consolidated statements of cash flows	$ 54,983	$ 69,533	$ 21,981

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 AND BASIS OF PRESENTATION

Business

Dicerna™ Pharmaceuticals, Inc. ("Dicerna" or the "Company"), a Delaware corporation founded in 2006 and headquartered in Cambridge, Massachusetts, is a biopharmaceutical company focused on the discovery and development of innovative subcutaneously delivered ribonucleic acid ("RNA") interference ("RNAi")-based pharmaceuticals using its GalXC™ RNAi platform for the treatment of diseases involving the liver, including rare diseases, viral infectious diseases, chronic liver diseases, and cardiovascular diseases. Within these therapeutic areas, the Company believes its GalXC RNAi platform will allow the Company to build a broad pipeline of therapeutics with attractive pharmaceutical properties, including a subcutaneous route of administration, infrequent dosing (e.g., dosing that is monthly or quarterly, and potentially even less frequent), high therapeutic index, and specificity to a single target gene.

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. All intercompany balances and transactions have been eliminated in consolidation.

Reclassifications

Effective January 1, 2018, the Company changed the presentation of the income from government grants from the caption "Grant revenue" to an offset to research and development expenses. Also, effective April 1, 2018, the Company changed the presentation of certain litigation-related expenses associated with the litigation with Alnylam Pharmaceuticals, Inc. ("Alnylam") from the caption "General and administrative" expense to "Litigation expense." The changes associated with changes in presentation were applied retrospectively through the recast of affected prior period amounts in the consolidated statements of operations. The primary effects of such changes were:

- the reclassification of grant income from revenue to the presentation as an offset to research and development expenses of $1.1 million and $0.3 million for the years ended December 31, 2017 and 2016, respectively; and
- the reclassification of certain litigation-related expenses historically included in general and administrative expense to litigation expense in the consolidated statements of operations of $9.0 million and $2.9 million for the years ended December 31, 2017 and 2016, respectively.

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 consolidated financial statements, as well as the revenues and expenses incurred during the reporting periods. On an ongoing basis, the Company evaluates its judgments and estimates, including those related to revenue recognition 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 value 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.

Liquidity

The Company had cash, cash equivalents, and held-to-maturity investments of $302.6 million as of December 31, 2018. The Company believes that its current cash, cash equivalents, and held-to-maturity investments as of December 31, 2018 will be sufficient to fund the execution of its current clinical and operating plan beyond 2020. This estimate assumes no new funding from additional collaboration agreements or from external financing events and no significant unanticipated changes in costs and expenses. In early 2019, the Company received $5.0 million from BI for the Option Payment and $100.0 million for the upfront cash payment from the Company's recent collaboration with Eli Lilly and Company ("Lilly"), and also paid $10.5 million to Alnylam for the Confidential Settlement Agreement and General Release ("Settlement Agreement").

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

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 includes the balance of funds held in a money market collateral account that is restricted to secure a letter of credit for the Company's operating lease for office and laboratory space at 87 Cambridgepark Drive in Cambridge, Massachusetts. The letter of credit is required to be maintained throughout the term of the Company's lease, which expires on November 30, 2020.

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 year ended December 31, 2018 are a result of the Company's collaboration agreements with Boehringer Ingelheim ("BI") and Alexion Pharmaceuticals, Inc. ("Alexion"). BI represented substantially all of the Company's revenue from collaborative arrangements for the years ended December 31, 2018 and 2017. All revenues recognized by the Company to date were earned in the U.S.

At December 31, 2018, the balance of the Company's contract receivables was solely related to the non-refundable, non-creditable upfront payment due to the Company in connection with a collaboration agreement entered into with Lilly (see Note 8 – Collaborative Research and License Agreements). The Company did not have any contract receivables at December 31, 2017.

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. For the year ended December 31, 2018, the Company had one contract manufacturing relationship which accounted for approximately 10.9% of the Company's total purchases.

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 provided 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, 2018, the balance of construction in process includes costs associated with laboratory equipment under installation and the construction of certain leasehold improvements.

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, 2018, 2017, and 2016, no impairments were recorded.

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 its operations and manages its 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, overhead expenses and other outside expenses. Research and development costs are expensed as incurred. 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. The Company records grants from governmental and non-profit agencies 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 preclinical, clinical, regulatory, and sales-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 and 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 prospectively as a change in accounting estimate.

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 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 options represent 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 a separate performance obligation, 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 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" (more than 50 percent) 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,		
	2018	2017	2016
Options to purchase common stock	7,787,690	6,124,096	5,099,449
Warrants to purchase common stock	2,198	87,901	87,901
Nonvested restricted common stock	—	10,000	20,000
Total	7,789,888	6,221,997	5,207,350

Comprehensive loss

Comprehensive loss is defined as the change in stockholders' equity of a business enterprise during a period from transactions and other events and circumstances from non-owner sources. The Company has no comprehensive loss items other than net loss.

Recent accounting pronouncements

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

Standard	Description	Effective Date for Company	Effect on the Consolidated Financial Statements
Accounting Standards Adopted During the Year Ended December 31, 2018			
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).
ASU No. 2016-18, Statement of Cash Flows (Topic 230): Restricted Cash ("ASU 2016-18")	In November 2016, the FASB issued ASU No. 2016-18, *Statement of Cash Flows (Topic 230): Restricted Cash* ("ASU 2016-18"), a consensus of the FASB's EITF. ASU 2016-18 requires that the statement of cash flows explain the change during the period in the total of cash and cash equivalents, including amounts generally described as restricted cash or restricted cash equivalents. Entities are required to reconcile such total to amounts on the balance sheet and disclose the nature of the restrictions. By requiring that the statement of cash flows explain the change during the period in the total of cash, cash equivalents and restricted cash, the new guidance eliminates current diversity in practice.	January 1, 2018	The Company adopted ASU 2016-18 on January 1, 2018 and applied this new guidance retrospectively to all periods presented. Consequently, transfers between restricted and unrestricted cash equivalents accounts are no longer reported as a cash flow in the Company's consolidated statement of cash flows. As a result of the adoption of this standard, the Company includes its restricted cash equivalents balance in the cash and cash equivalents reconciliation of operating, investing and financing activities. The retrospective adoption resulted in the inclusion of restricted cash equivalents of $0.7 million, and $1.1 million in the consolidated statements of cash flows as of December 31, 2017 and 2016, respectively.

Standard	Description	Effective Date for Company	Effect on the Consolidated Financial Statements
Recently Issued Accounting Standards Not Yet Adopted			
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 will be effective for the Company beginning in the first quarter of 2019. 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 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	Management expects that the adoption of ASU 2016-02 will result in the recognition of a right of use asset and related liability associated with the Company's non-cancelable operating lease arrangements for office and laboratory spaces (see Note 14 – Commitments and Contingencies and Note 17 - Subsequent Events). The Company is in the process of determining whether it will utilize the optional transition method presented in ASU 2018-11.

Change in accounting principle

In May 2014, the Financial Accounting Standards Board ("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 has 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 from collaborative 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.

As the Company did not have any revenue from collaborative arrangements during the year ended December 31, 2016, the adoption of ASC 606 did not have an impact on the beginning balance of accumulated deficit for the earliest period presented in the Consolidated Statements of Changes in Redeemable Convertible Preferred Stock and Stockholders' Equity.

3. 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 24 months. In addition, the weighted-average maturity of the investment portfolio must not exceed 12 months.

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

DESCRIPTION	DECEMBER 31, 2018 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

DESCRIPTION	DECEMBER 31, 2017 AMORTIZED COST	GROSS UNREALIZED HOLDING GAINS	GROSS UNREALIZED HOLDING LOSSES	FAIR VALUE
U.S. Treasury securities maturing in one year or less	$ 44,889	$ —	$ (30)	$ 44,859

4. 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.

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

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

DESCRIPTION	DECEMBER 31, 2017 TOTAL FAIR VALUE	LEVEL 1	LEVEL 2	LEVEL 3
Cash equivalents				
Money market funds	$ 51,441	$ 51,441	$ —	$ —
Held-to-maturity investments				
U.S. Treasury securities	44,859	—	44,859	—
Restricted cash equivalents				
Money market funds	744	—	744	—
Total	$ 97,044	$ 51,441	$ 45,603	$ —

The Company's 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, 2018 and 2017.

The Company's held-to-maturity investments and restricted cash equivalents 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, 2018 and 2017.

As of December 31, 2018 and 2017, 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. As of December 31, 2017, the carrying amount of the withholding tax receivable also approximated its estimated fair value due to the short-term nature of the instrument.

As of December 31, 2018, the Company had a remaining cash obligation of $10.5 million payable to Alnylam (see Note 15). Upon receipt of certain upfront cash payment owed to the Company resulting from signing the Lilly Collaboration Agreement in October 2018, the Company anticipates that the cash obligation will be payable in the first quarter of 2019 and has therefore adjusted the liability equal to the estimated present value of the obligation of $10.5 million and included the obligation in current liabilities at December 31, 2018. As the present value of the litigation settlement payable at December 31, 2018 was determined using market rates based on the nature of the obligation and the Company's creditworthiness, the carrying value approximates the fair value. There was no liability recorded related to the settlement as of December 31, 2017.

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.

5. PREPAID EXPENSES AND OTHER CURRENT ASSETS

Prepaid expenses and other current assets consist of the following:

	DECEMBER 31,	
	2018	2017
Prepaid clinical, contract research, and manufacturing costs	$ 1,419	$ 1,931
Interest receivable and other current assets	815	391
Prepaid insurance	341	318
Prepaid rent	245	239
Other	68	536
Prepaid expenses and other current assets	$ 2,888	$ 3,415

6. PROPERTY AND EQUIPMENT, NET

Property and equipment, net, consists of the following:

	DECEMBER 31,	
	2018	2017
Laboratory equipment	$ 4,607	$ 4,410
Office and computer equipment	1,021	900
Furniture and fixtures	479	479
Leasehold improvements	257	257
Construction in process	1,661	—
Property and equipment, at cost	8,025	6,046
Less accumulated depreciation and amortization	(5,307)	(4,534)
Property and equipment, net	$ 2,718	$ 1,512

Depreciation and amortization expense was $0.8 million for each of the years ended December 31, 2018, 2017, and 2016.

7. ACCRUED EXPENSES AND OTHER CURRENT LIABILITIES

Accrued expenses and other current liabilities consist of the following:

	DECEMBER 31,	
	2018	2017
Accrued clinical, contract research, and manufacturing costs	$ 3,960	$ 1,860
Accrued compensation and related benefits	3,684	1,987
Accrued professional fees	1,693	1,488
Accrued other expenses	312	391
Accrued expenses and other current liabilities	$ 9,649	$ 5,726

8. COLLABORATIVE RESEARCH AND LICENSE AGREEMENTS

Lilly collaboration and share purchase agreements

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 to progress new drug targets toward clinical development and commercialization. In addition, the Company and Lilly will collaborate to extend the GalXC RNAi 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, non-creditable 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. The Combined Agreements were subject to customary closing conditions and clearances, including clearance under the Hart-Scott-Rodino Antitrust Improvements Act, and closed in December 2018.

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 a new platform, and participation on a joint steering committee. The Company determined that the performance obligations 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 performance obligations. As such, the Company concluded that there is 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.

No revenue was recognized under the Lilly Collaboration Agreement during the year ended December 31, 2018. 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, 2018 relates to the Company's wholly unsatisfied performance obligation. This amount is recorded as a contract liability presented in deferred revenue at December 31, 2018 is $148.7 million, of which $54.0 million is included in the current portion of deferred revenue. As of December 31, 2018, the Company expected to recognize this amount over the remaining research term of the agreement, which is expected to extend through the first quarter of 2022, with the majority being recognized through the fourth quarter of 2021.

Alexion collaboration and equity agreements

On October 22, 2018, the Company and Alexion Pharma Holding Unlimited Company ("Alexion Pharma Holding"), an affiliate of Alexion Pharmaceuticals, Inc. ("Alexion Pharmaceuticals" and, together with Alexion Pharma Holding, "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 of the GalXC candidates through the completion of Phase 1, and the 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 for two of the Company's preclinical, subcutaneously delivered GalXC RNAi candidates and an exclusive option for the discovery and development of GalXC RNAi candidates against two additional complement pathway targets.

Under the terms of the Alexion Collaboration Agreement, Alexion agreed to pay the Company a non-refundable, non-reimbursable, and non-creditable 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 is comprised of: (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 stated 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.

Alexion selected two targets upon entry into the Alexion Collaboration Agreement, which, as noted above, provides Alexion with the option to select up to two additional targets, in exchange for an option fee payment of $10.0 million for each selected target.

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 granting 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) the Company's 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 license, 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. 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.

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 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.

During the year ended December 31, 2018, the Company recognized $0.1 million as revenue under the Alexion Agreements 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, 2018 is $31.3 million, of which $11.7 million is included in current portion of deferred revenue. As of December 31, 2018, the Company expects to recognize this amount over the remaining research program term, which is estimated to extend through the fourth quarter of 2023, with the majority being recognized through the fourth quarter of 2021.

BI Agreement and related amendments

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.

During the term of the research program, BI will reimburse Dicerna the cost of certain materials and third-party expenses that have been included in the preclinical studies. 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 provided 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.

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 performance obligations 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 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 was 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 Company re-evaluates the transaction price in each reporting period and as uncertain events are resolved or other changes in circumstances occur and adjusts the transaction price as necessary.

The $10.3 million transaction price is recognized over the research term, currently estimated to extend through August 2019, which represents the Company's current best estimate of the period of the obligation to provide research support services to BI. Related revenue is recognized on a straight-line basis, which is in management's judgment an appropriate measure of progress toward satisfying the performance obligation, largely in absence of evidence that obligations are fulfilled in a specific pattern.

BI contract amendment

In October 2018, BI exercised its Second Target option, which entitles the Company to a non-refundable payment of $5.0 million 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 will be 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.

Management determined that the addition of the Second Target upon exercise of the Second Target Option resulted in a new contract for accounting purposes, and the $5.0 million exercise price was representative of the standalone selling price. The exercise of the Second Target option on December 31, 2018 through the ATA created a new contract for accounting purposes. 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 will re-evaluate the transaction price in each reporting period and as uncertain events are resolved or other changes in circumstances occur. The $5.0 million transaction price, of which no revenue was recognized in 2018 as the program had not yet commenced, will be recognized over the research term, which is currently estimated to extend through June 2022.

In addition to establishing the terms of the Second Target option exercise, the ATA also amends the BI Agreement to provide BI with the option to add, over a three-year period, the development of product candidates targeting a further additional target gene (the "Third Target Option").

Per the ATA, if BI elects, in its sole discretion, to exercise the Third Target Option, the parties would 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 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 contract 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 Target.

During the year ended December 31, 2018, the Company recognized $6.1 million of revenue related to the BI Agreement, as amended, 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, 2018 is $3.2 million, all of which is included in current portion of deferred revenue. The Company expected to recognize this amount over the remaining research program term, which is eight months as of December 31, 2018.

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

	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

	YEAR ENDED DECEMBER 31, 2017			
	BALANCE AT BEGINNING OF PERIOD	ADDITIONS	DEDUCTIONS	BALANCE AT END OF PERIOD
Deferred revenue, current and noncurrent	$ —	$ 10,300	$ (1,030)	$ 9,270

The Company had no deferred revenue during the year ended December 31, 2016.

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, 2018 and 2017, 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 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. The Company completed the sale of 8,832,565 shares to the 2018 Underwriters on September 11, 2018; the sale resulted in the receipt of 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 stated purchase price of approximately $15.0 million, of which $9.1 million was allocated to the share issuance for accounting purposes. Pursuant to the terms of the Alexion Share Issuance Agreement, Alexion may not, without the prior approval of the Company, dispose of any of the Alexion shares for a six-month period of time commencing on the closing date of the Alexion Share issuance.

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 stated 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.

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 28, 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, 2018, 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");

2014 Employee Stock Purchase Plan ("2014 ESPP"); 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 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, 2018, there were 872,411 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, 2018, 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. There were no stock options granted pursuant to the 2016 Plan during the year ended December 31, 2018.

As of December 31, 2018, the Company has 2,875,000 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,		
	2018	2017	2016
Research and development expenses	$ 3,062	$ 3,536	$ 4,467
General and administrative expenses	4,826	4,234	4,698
Total	$ 7,888	$ 7,770	$ 9,165

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,		
	2018	2017	2016
Common stock price	$9.14 - $15.74	$2.49 – $9.71	$2.94 – $9.09
Expected option term (in years)	5.50 - 6.25	5.50 – 6.25	5.50 – 6.25
Expected volatility	75.9% - 78.3%	79.4% – 91.1%	70.9% – 79.4%
Risk-free interest rate	2.3% - 3.0%	1.9% – 2.2%	1.2% – 2.0%
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, 2018	6,124,096	$ 8.58		
Granted	2,241,350	$ 11.07		
Exercised	(329,934)	$ 5.31		
Forfeited/Canceled	(90,026)	$ 5.71		
Expired	(157,796)	$ 14.08		
OUTSTANDING – DECEMBER 31, 2018	7,787,690	$ 9.36	7.3	$ 24,305
EXERCISABLE – DECEMBER 31, 2018	4,842,084	$ 9.71	6.4	$ 16,151
VESTED AND EXPECTED TO VEST – DECEMBER 31, 2018	7,567,801	$ 9.30	7.2	$ 23,948

The weighted average grant date fair value of stock options granted during the years ended December 31, 2018, 2017, and 2016 was $7.64, $2.52, and $4.60 per share, respectively. As of December 31, 2018, there was $17.1 million of unrecognized compensation cost related to unvested employee stock options which are expected to be recognized over a weighted average period of 2.9 years. The intrinsic value of stock options exercised was $2.9 million, $0.1 million, and $0.2 million for the years ended December 31, 2018, 2017, and 2016, 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 years ended December 31, 2018 and 2016 was $0.1 million and $0.1 million, respectively. The total fair value of restricted common stock that vested during the year ended December 31, 2017 was immaterial.

Common stock warrants

At December 31, 2017, the Company had 87,901 common stock warrants outstanding with a weighted average exercise price of $13.80. All of the Company's outstanding common stock warrants have been exercisable since November 30, 2013.

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 December 31, 2018, there were 2,198 common stock warrants remaining outstanding with an exercise price of $250.00 per share and a remaining contractual life of 1.46 years.

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, 2018, there were 2,107,791 shares of common stock authorized and 1,845,179 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 to in calculating the estimates of fair value. Stock-based compensation expense related to stock purchase rights under the 2014 ESPP was $0.1 million, $0.4 million, $0.4 million and for the years ended December 31, 2018, 2017, and 2016.

During the years ended December 31, 2018, 2017, and 2016, the Company issued 118,239, 84,890, and 36,501 shares of common stock under the 2014 ESPP, respectively. The weighted average purchase price of shares issued under the 2014 ESPP were $2.61, $2.45, and $4.53 per share for the years ended December 31, 2018, 2017, and 2016, 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 $0.6 million, $0.4 million, and $0.2 million for the years ended December 31, 2018, 2017, and 2016, respectively. There were no discretionary profit sharing contributions made by the Company during the years ended December 31, 2018, 2017, or 2016.

13. INCOME TAXES

The Company has no current and no deferred income tax expense for the years ended December 31, 2018 and 2017, respectively. The Company did not record a federal income tax provision or benefit for the years ended December 31, 2018, 2017, and 2016, respectively.

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,		
	2018	2017	2016
Federal statutory rate	21.0 %	34.0 %	34.0 %
Effect of:			
Foreign rate differential	(9.5)%	(17.6)%	(31.4)%
Tax reform	— %	(29.6)%	— %
Net operating loss limitation	(23.0)%	— %	— %
Change in valuation allowance	10.6 %	13.5 %	— %
Research and development tax credit	0.5 %	0.6 %	(0.7)%
Stock-based compensation expense	0.4 %	(0.8)%	(0.9)%
Other	— %	(0.1)%	(1.0)%
Total	— %	— %	— %

The components of the Company's deferred tax assets are as follows:

	DECEMBER 31,	
	2018	2017
Deferred tax assets:		
Net operating loss carryforwards	$ 24,739	$ 32,008
Capitalized research and development costs	516	618
Research and development credit carryforwards	3,988	3,481
Stock-based compensation expense	7,644	6,066
Depreciation expense and other costs	75	42
Net deferred tax assets	36,962	42,215
Valuation allowance	(36,962)	(42,215)
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. As a result of the newly enacted law, the Company was required to revalue all deferred tax assets and liabilities existing as of December 31, 2017 so as to reflect the reduction in the federal tax rate. This revaluation resulted in a reduction to the Company's deferred tax asset of $17.8 million at December 31, 2017, with a corresponding reduction to the Company's valuation allowance. Consequently, there was no impact on the accompanying consolidated financial statements that resulted from the reduction in the federal tax rate. Other relevant provisions of the TCJA did not have a material impact on the accompanying consolidated financial statements.

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, 2018 and 2017.

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, 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. At this time, there is an estimated limitation of approximately $97.0 million of net operating losses.

As of December 31, 2018, the Company had approximately $158.7 million of federal and $148.2 million of state net operating loss carryforwards. If not utilized, the federal and state net operating loss carryforwards expire starting in 2028 and 2030, respectively. Additionally, as of December 31, 2018, the Company had $2.6 million of federal and $1.4 million of Massachusetts tax credits that expire starting in 2028 and 2023, respectively.

As of December 31, 2018, the Company had $1.6 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, 2018 and 2017, the Company had no accrued penalties or provisions for interest.

A reconciliation of the gross unrecognized tax benefit is as follows:

	YEAR ENDED DECEMBER 31,	
	2018	2017
Unrecognized tax benefits at the beginning of the period	$ 1,451	$ 1,210
Additions for current tax positions	211	243
Changes for previous tax positions	(31)	(2)
Unrecognized tax benefits at the end of the period	$ 1,631	$ 1,451

The Company files income tax returns in the United States, the Commonwealth of Massachusetts, Colorado, and New Jersey. The tax years 2008 through 2017 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. COMMITMENTS AND CONTINGENCIES

Facility lease

On July 11, 2014, the Company executed a non-cancelable operating lease for office and laboratory space in Cambridge, Massachusetts. 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 lease agreement, the Company established a letter of credit, secured by a restricted money market account, the balance of which is presented as restricted cash equivalents at December 31, 2018 and 2017.

Future minimum lease payments on the Company's non-cancelable operating lease for office and laboratory space are as follows:

YEARS ENDING DECEMBER 31,	OPERATING LEASE
2019	$ 1,678
2020	1,581
Total	$ 3,259

Rent expense was $1.6 million for each of the years ended December 31, 2018, 2017, and 2016.

Legal proceedings

From time to time, the Company may be subject to various claims and legal proceedings. 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, 2018 or 2017.

15. LITIGATION

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. The terms of the Settlement Agreement include mutual releases and dismissals with prejudice of all claims and counterclaims in the following litigation between the parties: (i) Alnylam Pharmaceuticals, Inc. v. Dicerna Pharmaceuticals, Inc., No. 15-4126 pending in the Massachusetts Superior Court for Middlesex County and (ii) Dicerna Pharmaceuticals, Inc., v. Alnylam Pharmaceuticals, Inc. No.1:17-cv-11466 pending in the United States District Court for the District of Massachusetts. Pursuant to the terms of the Settlement Agreement, the Company has 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 10.0% 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 10.0%. 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 is 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 related the receipt the non-refundable, non-reimbursable, and non-creditable 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. 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.

16. QUARTERLY FINANCIAL DATA (UNAUDITED)

The following tables contain selected quarterly financial information for the years ended December 31, 2018 and 2017. The Company believes that the following information reflects all normal recurring adjustments necessary for a fair statement of the information for the periods presented.

	2018				
	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	TOTAL YEAR
Revenue from collaborative arrangements	$ 1,545	$ 1,545	$ 1,545	$ 1,541	$ 6,176
Net loss	$ (15,579)	$ (35,644)	$ (19,020)	$ (18,610)	$ (88,853)
Net loss attributable to common stockholders	$ (15,579)	$ (35,644)	$ (19,020)	$ (18,610)	$ (88,853)
Net loss per share attributable to common stockholders – basic and diluted	$ (0.30)	$ (0.68)	$ (0.35)	$ (0.29)	$ (1.60)

	2017				
	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	TOTAL YEAR
Revenue from collaborative arrangements	$ —	$ —	$ —	$ 1,030	$ 1,030
Net loss	$ (14,201)	$ (15,225)	$ (15,033)	$ (15,741)	$ (60,200)
Net loss attributable to common stockholders	$ (14,201)	$ (23,991)	$ (19,144)	$ (22,956)	$ (80,292)
Net loss per share attributable to common stockholders – basic and diluted	$ (0.68)	$ (1.15)	$ (0.92)	$ (0.91)	$ (3.66)

Net loss per share attributable to common stockholders 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 attributable to common stockholders may not equal the year-to-date net loss per share attributable to common stockholders.

17. SUBSEQUENT EVENTS

Lexington lease

On January 2, 2019, the Company entered into a non-cancelable real property lease agreement with Hayden Office Trust under a Declaration of Trust dated August 24, 1977, as the same may have been amended, for approximately 80,872 square feet of laboratory and office space in Lexington, Massachusetts (the "Lexington Lease"). The Company intends to move its corporate headquarters and research facility to this location upon occupancy, which is expected to occur in the fourth quarter of 2019.

The original term (the "Original Term") of the Lexington Lease is seven years, commencing on the earlier of (a) the date on which the premises are ready for occupancy under the terms of the lease, or (b) the date on which the Company commences occupancy of any portion of the premises for the permitted uses under the lease. The Company has options to extend the term of the lease for two additional successive periods of five years each (the "Extension Periods").

Annual fixed rent will be 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. Annual fixed rent during the Extension Periods will be agreed upon between the Company and the Landlord following the Company's provision of notice of its intention to exercise an extension option. If the Company and the Landlord cannot agree on annual fixed rent during an Extension Period, the Company 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, the Company 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 the Company fails to cure certain breaches of its obligations under the lease within specified periods of time. In addition, the Company will be obligated to indemnify the landlord for certain losses incurred in connection with the Company's use or occupancy of the premises.

Cambridge sublease

On January 4, 2019, the Company entered into a non-cancelable real property sublease agreement with PPF OFF 150 Cambridge Park Drive, LLC (the "Landlord") and International Business Machines Corporation (the "Sublandlord"), 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.

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, 2018 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, 2018.

Attestation Report of the Registered Public Accounting Firm

This Annual Report on Form 10-K does not include an attestation report of our independent registered public accounting firm as we are a smaller reporting company and an "emerging growth company" as of December 31, 2018, as defined in the Jumpstart Our Business Startups Act of 2012.

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 quarter ended December 31, 2018, 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

None.

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 2019 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 controller, 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	Specimen Common Stock Certificate.	S-1	333-193150	4.1	January 28, 2014
4.1A	Form of Redeemable Convertible Preferred Stock Certificate.	8-K	001-36281	4.1	March 30, 2017
4.2	Form of Warrant to Purchase Common Stock.	S-1	333-193150	4.2	December 31, 2013
4.3	Form of Warrant to Purchase Preferred Stock.	S-1	333-193150	4.3	December 31, 2013
4.4	Form of Amended and Restated Registration Rights Agreement.	8-K	001-36281	10.2	March 30, 2017
4.4A	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
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

Exhibit Number	Description of Documents	Incorporated by Reference			
		Form	File Number	Exhibit	Filing Date
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.	8-K	001-36281	10.1	July 7, 2015
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+	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
10.19+	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
10.20+	Dicerna Pharmaceuticals, Inc. 2016 Inducement Plan.	S-8	333-210071	4.3	March 10, 2016
10.21+	Form of Dicerna Pharmaceuticals, Inc. Non-Qualified Inducement Stock Option Agreement.	S-8	333-210071	4.2	March 10, 2016
10.22+	Form of Non-Plan Inducement Stock Option Agreement.	S-8	333-210071	4.4	March 10, 2016
10.23+	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
10.24+	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
10.25+	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
10.26+	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
10.27	Form of Letter Agreement by and between the Company and Adam Koppel.	8-K	001-36281	10.3	March 30, 2017
10.28	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
10.29+	Employment Agreement, dated May 18, 2017, by and between the Company and Ralf Rosskamp.	10-Q	001-36281	10.3	August 10, 2017
10.30	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
10.31	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
10.32†	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
10.33	Share Issuance Agreement, dated April 20, 2018, between the Company and Alnylam Pharmaceuticals, Inc.	10-Q	001-36281	10.2	August 8, 2018
10.34†*	Collaborative Research and License Agreement, dated October 22, 2018, by and between the Company and Alexion Pharma Holding Unlimited Company.				
10.35*	Alexion Share Issuance Agreement, dated October 22, 2018, by and between the Company and Alexion Pharma Holding Unlimited Company.				
10.36†*	Collaboration and License Agreement, dated October 25, 2018, by and between the Company and Eli Lilly and Company.				
10.37*	Lilly Share Issuance Agreement, dated October 25, 2018, by and between the Company and Eli Lilly and Company.				
10.38†*	Additional Target Agreement, dated December 31, 2018, by and between the Company and Boehringer Ingelheim International GmbH.				
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.
+ 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 Cambridge, Commonwealth of Massachusetts on March 13, 2019.

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 ratify 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)	March 13, 2019
/s/ John B. Green **John B. Green**	Chief Financial Officer (Principal Financial Officer and Principal Accounting Officer)	March 13, 2019
/s/ Kevin Buchi **Kevin Buchi**	Chairman	March 13, 2019
/s/ Anna Protopapas **Anna Protopapas**	Director	March 13, 2019
/s/ Martin Freed **Martin Freed, M.D.**	Director	March 13, 2019
/s/ Brian K. Halak **Brian K. Halak, Ph.D.**	Director	March 13, 2019
/s/ Stephen J. Hoffman **Stephen J. Hoffman, MD., Ph.D.**	Director	March 13, 2019
/s/ Peter Kolchinsky **Peter Kolchinsky, Ph.D.**	Director	March 13, 2019
/s/ Adam M. Koppel **Adam M. Koppel, M.D., Ph.D.**	Director	March 13, 2019
/s/ Marc Kozin **Marc Kozin**	Director	March 13, 2019
/s/ Dennis H. Langer **Dennis H. Langer, M.D., J.D.**	Director	March 13, 2019
/s/ Cynthia Smith **Cynthia Smith**	Director	March 13, 2019

COLLABORATIVE RESEARCH AND LICENSE AGREEMENT

between

Alexion Pharma Holding Unlimited Company

Dicerna Pharmaceuticals Inc.

and

Dicerna Cayman

DATED OCTOBER 22, 2018

COLLABORATIVE RESEARCH AND LICENSE AGREEMENT

THIS COLLABORATIVE RESEARCH AND LICENSE AGREEMENT (this " **Agreement**") is entered into as of October 22, 2018 (the "**Effective Date**") by and among ALEXION PHARMA HOLDING UNLIMITED COMPANY, an unlimited liability company incorporated under the laws of Ireland with a principal place of business at [***] ("**ALEXION**"), DICERNA PHARMACEUTICALS INC., a corporation organized and existing under the laws of Delaware with a principal place of business at 87 Cambridgepark Drive, Cambridge, MA 02140 ("**DICERNA PHARMA**"), and Dicerna Cayman, an exempted company incorporated with limited liability under the laws of the Cayman Islands ("**DICERNA CAYMAN**", and together with DICERNA PHARMA, "**DICERNA**"). ALEXION and DICERNA are sometimes referred to herein individually as a "**Party**" and collectively as the "**Parties**".

RECITALS

WHEREAS, ALEXION is engaged in, among other things, discovery, clinical Development and Commercialization of pharmaceutical products and has expertise in diseases involving the complement pathway;

WHEREAS, DICERNA has certain proprietary RNAi technology, known as DICERNA's GalXC technology, that enables precise silencing of genes in the liver, specifically targeting hepatocytes;

WHEREAS, the Parties are interested in entering into a collaboration to utilize DICERNA's expertise and proprietary GalXC technology to perform research and development activities to identify candidate products for certain named targets in the complement pathway, as well as certain additional unnamed targets in the complement pathway, which candidate products, once selected, would be further developed by the Parties and commercialized by ALEXION, in accordance with the terms and conditions set forth in this Agreement; and

WHEREAS, DICERNA desires to grant to ALEXION, and ALEXION desires to receive from DICERNA, an exclusive, worldwide license under the Licensed Intellectual Property to exploit Products in the Field in the Territory (each as defined below).

NOW, THEREFORE, the Parties hereto agree as follows:

1. DEFINITIONS

1.1 "**Additional Complement Pathway Target(s)**" means the complement targets listed on APPENDIX 2**.**

1.1 "**Additional Cure Period**" has the meaning set forth in Section 13.2.3.

1.2 "**Additional Research Work Plan**" means, with respect to each Additional Complement Pathway Target for which ALEXION exercises a Target Option, the written summary of the specific research activities to be conducted by DICERNA under the Research Program, the timelines for completion of such activities and the corresponding Candidate Product Criteria

with respect to such Additional Complement Pathway Target. Upon approval by the JSC, each Additional Research Work Plan shall be attached to this Agreement as an addition to APPENDIX 1(a) and incorporated herein.

1.3 "**Acquirer**" has the meaning set forth in Section 14.1.

1.4 "**Affiliates**" means, with respect to a Party or Third Party, any company or business or entity controlled by, controlling, or under common control with such Party or Third Party. For the purpose of this definition, "control" means direct or indirect beneficial ownership of at least fifty percent (50%) interest in the voting stock (or the equivalent) of such person or entity or having the right to direct, appoint or remove a majority or more of the members of its board of directors (or their equivalent), or having the power to control the general management of such person or entity, by contract, law or otherwise.

1.5 "**ALEXION Background Intellectual Property**" means [***]

1.6 "**ALEXION Indemnitees**" has the meaning set forth in Section 12.1.

1.7 "**Applicable Law**" means all applicable laws, rules and regulations (including any rules, regulations, guidelines or other requirements of the Regulatory Authorities or other governmental agency) that may be in effect from time to time.

1.8 "**Auditor**" has the meaning set forth in Section 7.11.1.

1.9 "**Board of Directors**" has the meaning set forth in Section 1.18(i).

1.10 "**Business Day**" means any day other than (i) Saturday, (ii) Sunday or (iii) any day on which commercial banks in Boston, MA USA are authorized or required by law to remain closed.

1.11 "**Calendar Quarter**" means a period of three calendar months ending on March 31st, June 30th, September 30th or December 31st in any Calendar Year.

1.12 "**Calendar Year**" means a one-year period beginning on January 1st and ending on December 31st.

1.13 "**Candidate Product(s)**" means, on a Target-by-Target basis, the specific molecule(s) identified by DICERNA through the conduct of the Research Program and delivered to ALEXION in accordance with Section 2.2.2 that (a) meet the Candidate Product Criteria set forth in the Research Work Plan or (b) are otherwise designated by ALEXION as a Candidate Product pursuant to Section 2.2.3.

1.14 "**Candidate Product Criteria**" means, with respect to a Target, the success criteria agreed upon by the Parties for the molecules directed to such Target (e.g., [***] as set forth in the Research Work Plan.

1.15 "**cGMP**" means all applicable current good manufacturing practice requirements, standards and guidelines, including, as applicable, (a) the U.S. regulations related to current good

manufacturing practices for drugs, biologics, devices and combination products, including 21 C.F.R. Parts 4, 210, 211, 312 and 820 and related guidance documents, (b) European Directive 2003/94/EC and Eudralex 4, (c) the principles detailed in the International Conference on Harmonization's Q7 guidelines, and (d) the equivalent Applicable Law in any relevant country or region, each as may be applicable from time to time.

1.16 "**Change**" means with respect to a given Research Work Plan, Development Plan or Target Validation Work Plan, a revision or modification to such plan requested or directed by ALEXION that materially increases DICERNA's cost of performing its obligations under such Research Work Plan, Development Plan or Target Validation Work Plan.

1.17 "**Change of Control**" means, with respect to a Party, the occurrence of any of the following after the Effective Date:

i. any "person" or "group" (as such terms are defined below): (a) is or becomes the "beneficial owner" (as defined below), directly or indirectly, of shares of capital stock or other interests (including partnership interests) of such Party then outstanding and normally entitled (without regard to the occurrence of any contingency) to vote in the election of the directors, managers or similar supervisory positions ("**Voting Stock**") of such Party representing fifty percent (50%) or more of the total voting power of all outstanding classes of Voting Stock of such Party; or (b) has the power, directly or indirectly, to elect a majority of the members of the Party's board of directors, or similar governing body ("**Board of Directors**"); or

ii. such Party enters into a merger, consolidation or similar transaction with another Person (whether or not such Party is the surviving entity) and as a result of such merger, consolidation or similar transaction (a) the members of the Board of Directors of such Party immediately prior to such transaction constitute less than a majority of the members of the Board of Directors of such Party or such surviving Person immediately following such transaction; or (b) the Persons that beneficially owned, directly or indirectly, the shares of Voting Stock of such Party immediately prior to such transaction cease to beneficially own, directly or indirectly, shares of Voting Stock of such Party representing at least a majority of the total voting power of all outstanding classes of Voting Stock of the surviving Person in substantially the same proportions as their ownership of Voting Stock of such Party immediately prior to such transaction; or

iii. such Party sells or transfers to any Third Party, in one or more related transactions, properties or assets representing all or substantially all of such Party's consolidated total assets to which this Agreement relates; or

iv. the holders of capital stock of such Party approve a plan or proposal for the liquidation or dissolution of such Party.

For the purpose of this definition of "Change of Control," (a) "person" and "group" have the meanings given such terms under Section 13(d) and 14(d) of the United States Securities

Exchange Act of 1934 and the term "group" includes any group acting for the purpose of acquiring, holding or disposing of securities within the meaning of Rule 13d-5(b)(1) under the said Act; (b) a "beneficial owner" will be determined in accordance with Rule 13d-3 under the aforesaid Act; and (c) the terms "beneficially owned" and "beneficially own" will have meanings correlative to that of "beneficial owner."

1.18 "**Clinical Trial**" means a clinical trial in humans of a product, including a Phase I Clinical Trial, a Phase II Clinical Trial or a Phase III Clinical Trial.

1.19 "**CMO**" has the meaning set forth in Section 6.2.2.

1.20 "**Combination Product**" has the meaning set forth in Section 1.93.

1.21 "**Commercialization**", "**Commercializing**" or "**Commercialize**" means any and all activities related to the pre-marketing, launching, marketing, promotion (including advertising and detailing), labeling, pricing, distribution, storage, handling, offering for sale, selling, having sold, importing and exporting for sale, having imported and exported for sale, distribution, having distributed, customer service and support, and post-marketing safety surveillance and reporting of a product (including a Product), but not including Development or Manufacturing.

1.22 "**Commercially Reasonable Efforts**" means, [***].

1.23"**Competitive Activities**" means any Development or Commercialization activities with respect to any product or product candidates directed to one or more targets in the Complement Pathway.

1.24 "**Competitor**" means [***].

1.25 "**Complement Pathway**" means [***].

1.26 "**Confidential Information**" has the meaning as defined in Section 9.1.

1.1 "**Continuation Product**" has the meaning set forth in Section 13.6.3(a).

1.2 "**Control**" or "**Controlled**" means, with respect to any Intellectual Property, the possession by a Party or any of its Affiliates, whether by ownership or license (other than by a license granted under this Agreement), of the ability to grant to the other Party access to or ownership of such Intellectual Property, or, a license or a sublicense in, to or under such Intellectual Property, as provided herein, without requiring the consent of a Third Party or violating the terms of any agreement or other arrangement with any Third Party. A Party shall not be deemed to Control any Patent Rights or Know-How that are owned or controlled by an Acquirer, except to the extent that any such Patent Rights or Know-How were developed in the course of such Party's or such Acquirer's performance of activities under this Agreement or through the use or application of the other Party's Intellectual Property or Confidential Information.

1.1 "**Cover**", "**Covering**" or "**Covered**" means, with respect to a product, technology, process, method or mode of administration that, in the absence of ownership of or a license granted under a particular Valid Claim, the Manufacture, use, offer for sale, sale or importation of such product or composition of matter or the practice of such technology, process, method or mode of administration would infringe such Valid Claim or, in the case of a claim that has not yet issued, would infringe such claim if it were to issue and become a Valid Claim.

1.2 "**CPI**" means the Consumer Price Index for the US City Average (all times).

1.3 "**Damages**" has the meaning set forth in Section 12.1.

1.4 "**Debarred**" means, with respect to an individual or entity, that such individual or entity has been debarred or suspended under 21 U.S.C. §335(a) or (b), the subject of a conviction described in Section 306 of the FD&C Act, excluded from a federal or governmental health care program, debarred from federal contracting, convicted of or pled *nolo contendere* to any felony, or to any federal or state legal violation (including misdemeanors) relating to prescription drug products or fraud, the subject to OFAC sanctions or on the OFAC list of specially designated nationals, or the subject of any similar sanction of any governmental authority in the Territory.

1.5 "**Defaulting Party**" has the meaning set forth in Section 13.2.3.

1.6 "**Deliverables**" means any and all deliverables to be generated or provided by DICERNA in connection with the Research Activities, Target Validation Activities or Development Activities conducted by DICERNA for a Product under the applicable Research Program or Development Program, as specified in the applicable Research Plan, Target Validation Work Plan or Development Plan.

1.7 "**Develop**" or "**Development**" means non-clinical and clinical drug research and development activities, whether before or after Regulatory Approval, including drug metabolism and pharmacokinetics, translational research, toxicology, pharmacology, test method development and stability testing, process and packaging development and improvement, process validation, process scale-up, formulation development, delivery system development, quality assurance and quality control development, statistical analysis, conduct of Clinical Trials, regulatory affairs, the preparation and submission of regulatory filings, Clinical Trial regulatory activities, and any other activities directed towards obtaining or maintaining Regulatory Approval of any product (including a Product). Development includes use and importation of the relevant product to conduct such Development activities. Development will not include Commercialization activities.

1.8 "**Development Activities**" means the activities set forth in a Development Plan to be conducted by DICERNA with respect to a Product pursuant to a Development Program during the Initial Development Period for such Product.

1.9 "**Development Decision Notice**" means, with respect to a Candidate Product, a written notice provided by ALEXION to DICERNA notifying DICERNA as to whether ALEXION

has selected (or declined to select) such Candidate Product for further research, Development, and Commercialization pursuant to Section 2.2.3.

1.10 "**Development Milestone Event**" has the meaning set forth in Section 7.3.2.

1.11 "**Development Milestone Payment**" has the meaning set forth in Section 7.3.2.

1.12 "**Development Plan**" has the meaning set forth in Section 3.1.1.

1.13 "**Development Program**" means, on a Product-by-Product basis, the program of Development Activities undertaken for such Product during the Initial Development Period as set forth in the Development Plan for such Product.

1.14 "**Development Quality Agreement**" has the meaning set forth in Section 3.3.1.

1.15 "**DICERNA GalXC Technology**" means the RNAi platform that comprises synthetic, double stranded RNA molecules that trigger the RNAi interference pathway, and include chemical modifications, an extended oligonucleotide strand, and monovalent N-acetylgalactosamine (GalNAc) conjugated to individual bases.

1.16 "**DICERNA Indemnitees**" has the meaning set forth in Section 12.2.

1.17 "**Disclosing Party**" has the meaning set forth in Section 9.1.

1.18 "**Discontinuation Date**" means (a) with respect to a Target for which ALEXION has nominated a replacement Target pursuant to Section 2.2.2(b), the effective date of such nomination, and (b) with respect to a Target for which ALEXION has not delivered to DICERNA a Development Decision notice by the end of the last Evaluation Period for a Candidate Product directed to such Target, the date of either Party's written notice to the other Party notifying such other Party that such Target has become a Discontinued Target pursuant to Section 2.2.3.

1.19 "**Discontinued Target**" means any Target (a) that ALEXION replaces with a replacement Target pursuant to Section 2.2.2(b), or (b) for which ALEXION has not delivered to DICERNA a Development Decision notice by the end of the last Evaluation Period for a Candidate Product directed to such Target in accordance with Section 2.2.3.

1.20 "**Dollar**" means the U.S. dollar, and "$" will be interpreted accordingly.

1.21 "**Effective Date**" has the meaning set forth in the preamble.

1.22 "**EMA**" has the meaning set forth in Section 1.117.

1.23 "**Evaluation Period**" means, with respect to a Candidate Product, the period of time commencing upon the delivery of the Candidate Product report for such Candidate Product pursuant to Section 2.2.2 and ending [***] thereafter (unless such evaluation period is extended by the JSC in writing).

1.24 "**Exclusivity Period**" means, on a Target-by-Target basis or Additional Complement Pathway Target-by-Additional Complement Pathway Target basis, as applicable, the period commencing upon the Effective Date and lasting through the Research Program Term and for so long as [***].

1.25 "**Executive Officers**" has the meaning set forth in Section 14.8.

1.26 "**FD&C Act**" means the Federal Food, Drug and Cosmetic Act.

1.27 "**FDA**" has the meaning set forth in Section 1.117.

1.28 "**Field**" means any and all prophylactic, diagnostic and therapeutic uses in humans, including the use of Products for the diagnosis, treatment, palliation or prevention of any disease or medical or aesthetic condition in humans.

1.29 "**First Commercial Sale**" means, on a country-by-country and Product-by-Product basis, [***].

1.30 "**FTE**" means a qualified full time person, or more than one person working the equivalent of a full-time person, where "full time" is based upon a total of [***] working hours per Calendar Year of scientific or technical work carried out by a duly qualified employee of DICERNA. Overtime and work on weekends, holidays and the like shall 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.

1.31 "**FTE Rate**" means [***] per FTE for the Calendar Years 2018 and 2019, subject to annual increases beginning on January 1, 2020 to reflect any year to year percentage increase in the CPI for 2019 and each subsequent Calendar Year.

1.32 "**GalXC Foreground IP**" means [***].

1.33 "**GalXC Foreground Patent Rights**" shall have the meaning set forth in Section 10.3.1.

1.34 "**GAAP**" means the generally accepted accounting principles in the United States of America (US GAAP), which principles are currently used at the relevant time and consistently applied by the applicable Party.

1.35 "**GCP**" means all applicable 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 Harmonized Tripartite Guideline for Good Clinical Practice (ICH E6 R2) 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) U.S. Code of Federal Regulations Title 21, Parts 50 (Protection of Human Subjects), 56 (Institutional Review Boards), and 312 (Investigational New Drug Application), and (d) the equivalent Applicable Law in the

region in the Territory, each as applicable from time to time and in each case, that provide for, among other things, assurance that the clinical data and reported results are credible and accurate and protect the rights, integrity, and confidentiality of trial subjects.

1.36 "**Generic Competition**" means, with respect to a given Product or Combination Product in a given country in the Territory, that the sales of one (1) or more Generic Products in such country (other than a Generic Product sold by ALEXION or its Affiliates or by a Sublicensee under a license granted by ALEXION or its Affiliates) achieve, [***].

1.37 "**Generic Product**" means with respect to a given Product or Combination Product in a given country in the Territory, a product that (a) [***], (b) [***], and (c) is sold or marketed for sale in such country by a Third Party that has not obtained the rights to market or sell such product as a Sublicensee, subcontractor, or Third Party distributor of ALEXION or any of its Affiliates, Sublicensees, or subcontractors with respect to such Product.

1.38 "**GLP**" means all applicable good laboratory practice standards, including, as applicable, as set forth in the then-current good laboratory practice standards promulgated or endorsed by the U.S. Food and Drug Administration, as defined in 21 C.F.R. Part 58, and the equivalent Applicable Law in the region in the Territory, each as may be applicable from time to time.

1.39 "**Grant-Back Agreement**" has the meaning set forth in Section 13.6.3(b).

1.40 "**Grant-Back IP**" means, with respect to a given Continuation Product, (a) any Product IP that (i) [***], and (ii) [***], (b) [***] and (c) [***].

1.41 "**IND**" means an Investigational New Drug application described in §505(i) of the FD&C Act and subject to 21 C.F.R. Part 312 or any comparable filings outside of the United States required to commence human clinical trials in such country or region, and all supplements or amendments that may be filed with respect to the foregoing.

1.42 "**Indemnification Claim Notice**" has the meaning set forth in Section 12.3.

1.43 "**Indemnified Party**" has the meaning set forth in Section 12.3.

1.44 "**Indemnifying Party**" has the meaning set forth in Section 12.3.

1.45 "**Infringed Patent**" has the meaning set forth in Section 10.4.1.

1.46 "**Initial Development Period**" has the meaning set forth in Section 3.1.2.

1.47 "**Initial Research Work Plan**" means, with respect to the Initial Targets, the written summary attached hereto as APPENDIX 1(a) of the specific research activities to be conducted by DICERNA under the Research Program, the timelines for completion of such activities and the corresponding Candidate Product Criteria with respect to the Initial Targets.

1.48 **"Initial Targets**" means [***].

1.49 "**Initiation**" means the first dosing of the first subject in a Clinical Trial.

1.50 "**Insolvency Event**" has the meaning as defined in Section 13.3.

1.51 "**Intellectual Property**" or "**IP**" means all Patent Rights, rights to Inventions and New Inventions, Know-How and all applications and rights to apply for any of them, anywhere in the world.

1.52 "**Invention**" means any process, method, utility, formulation, composition of matter, article of manufacture, material, creation, discovery or finding, or any improvement thereof, that is conceived and/or reduced to practice, whether patentable or not.

1.53 "**Invoice**" means an original invoice sent by DICERNA to ALEXION with respect to any payment due hereunder meeting the reasonable requirements provided by ALEXION to DICERNA within thirty (30) days of the Effective Date.

1.54 "**Joint Know-How**" has the meaning set forth in Section 10.1.4.

1.55 "**Joint Patent Rights**" has the meaning set forth in Section 10.1.4.

1.56 "**Joint Steering Committee**" or "**JSC**" has the meaning set forth in Section 4.2.1.

1.57 "**Know-How**" means all scientific and technical information, know-how and data, in any tangible or intangible form and whether or not patentable, including trade secrets, specifications, instructions, processes, formulae, methods, practices, techniques, results, formulations, software, algorithms, technology, test data (including pharmacological, biological, chemical, biochemical, toxicological and clinical test data, analytical and quality control data and stability data), studies and procedures, and other technology applicable to compounds, formulations, compositions, products or to their Manufacture, research and Development, registration, use or Commercialization or methods of assaying or testing them and also including any and all presentations, summaries and analyses thereof.

1.58 "**Licensed Intellectual Property**" or "**Licensed IP**" means, on a Candidate Product-by-Candidate Product or Product-by-Product basis, as applicable, any and all Intellectual Property that is: (a) owned or Controlled by DICERNA or any of its Affiliates and (b) necessary or reasonably useful to Develop, have Developed, Manufacture, have Manufactured, use, have used, offer for sale, have offered for sale, sell, have sold, export, have exported, import, have imported, Commercialize, have Commercialized or otherwise exploit Candidate Products or Products.

1.59 "**Licensed Patent Rights**" has the meaning set forth in Section 10.3.1. The Licensed Patent Rights existing as of the Effective Date include the items set forth on APPENDIX 5 hereto.

1.60 "**MAA**" means an application for the authorization to market a product in any country or group of countries outside the U.S., as defined in the Applicable Laws and filed with the Regulatory Authority of a given country or group of countries.

1.61 "**Major European Market**" means any of [***].

1.62 "**Manufacture**" or "**Manufacturing**" means any and all activities directed to manufacturing, processing, packaging, labeling, filling, 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.

1.63 "**NDA**" means a New Drug Application, as defined in §505 of the FD&C Act and applicable regulations promulgated thereunder in the United States, or any analogous application or submission with any Regulatory Authority to obtain authorization to market a pharmaceutical product outside of the United States.

1.64 "**Net Sales**" [***].

1.65 "**New Invention**" means any Invention that is first conceived, first reduced to practice or otherwise first discovered by or on behalf of either or both Parties in the course of conducting the Target Validation Activities, Research Activities or Development Activities.

1.66 "**Non-Defaulting Party**" has the meaning set forth in Section 13.2.3.

1.67 "**Non-Sublicensing Party**" has the meaning set forth in Section 10.2.5.

1.68 "**Option Exercise Notice**" has the meaning set forth in Section 2.6.2.

1.69 "**Option Period**" has the meaning set forth in Section 2.6.2.

1.70 "**Orange Book**" has the meaning set forth in Section 10.4.4.

1.71 "**Other Component(s)**" has the meaning set forth in Section 1.93.

1.72 "**Paragraph IV Certification**" has the meaning set forth in Section 10.4.5.

1.73 "**Paragraph IV Proceeding**" has the meaning set forth in Section 10.4.5(b).

1.74 "**Patent Rights**" means any and all (i) patents, (ii) patent applications, including all provisional and non-provisional applications, Patent Cooperation Treaty (PCT) applications, substitutions, continuations, continuations-in-part, divisions and renewals, and all patent rights granted thereon, (iii) all patents-of-addition, reissues, re-examinations and extensions or restorations by existing or future extension or restoration mechanisms, including supplementary protection certificates and equivalents thereof, (iv) inventor's certificates, letters patent, or (v) any other substantially equivalent form of government issued right

substantially similar to any of the foregoing described in subsections (i) through (v) above, anywhere in the world.

1.75 "**Patent Term Extension**" has the meaning set forth in Section 10.6.

1.76 "**Per Product Annual Net Sales**" has the meaning set forth in Section 7.4.

1.77 "**Phase I Clinical Trial**" means a human clinical trial of a product, the principal purpose of which is a preliminary determination of safety in healthy individuals or patients, and that meets the requirements of 21 CFR § 312.21(a) or, if conducted in a country other than the United States, the foreign equivalent thereof.

1.78 "**Phase II Clinical Trial**" means a human clinical trial of a product, the principal purpose of which is a determination of safety and efficacy in the target patient population, and that meets the requirements of 21 CFR § 312.21(b) or, if conducted in a country other than the United States, the foreign equivalent thereof.

1.79 "**Phase III Clinical Trial**" means a human clinical trial of a product (whether or not specifically referred to as a Phase III trial), the design of which is acknowledged by the FDA to be sufficient for such clinical trial to satisfy the requirements of 21 CFR § 312.21(c) or, if conducted in a country outside the United States, a similar clinical trial prescribed by the applicable Regulatory Authority in such country which is acknowledged by such Regulatory Authority to be sufficient for such clinical trial to satisfy the requirements of a pivotal efficacy and safety clinical trial.

1.80 "**PMDA**" has the meaning set forth in Section 1.117.

1.81 "**Product(s)**" means any product incorporating a Candidate Product (or derivative thereof) for which ALEXION has delivered a Development Decision Notice stating that ALEXION elects to continue Development of such Candidate Product in accordance with Section 2.2.3.

1.82 "**Product IP**" means, on a Candidate Product-by-Candidate Product, Product-by-Product, or Target-by-Target basis, as applicable, any and all [***].

1.83 "**Product Patent Rights**" has the meaning set forth in Section 10.3.2.

1.84 "**Program Leaders**" has the meaning set forth in Section 4.1.1.

1.85 "**Quality Agreement**" has the meaning set forth in Section 6.3.1.

1.86 "**Receiving Party**" has the meaning set forth in Section 9.1.

1.87 "**Regulatory Approval**" means, with respect to a Product in a country in the Territory, (a) any and all licenses, registrations, authorizations and approvals of the applicable Regulatory Authority, including NDAs or any foreign equivalent thereof, as applicable, and (b) if applicable, any and all pricing or reimbursement authorizations and approvals, in each case

((a) and (b)) that are necessary to Manufacture, distribute, sell, obtain reimbursement for, market, use, store, and import such Product in such country.

1.88 "**Regulatory Authority**" means (i) any governmental authority, notified body or other organization in a country or region that regulates the Manufacture or sale of pharmaceutical or medicinal products or medical devices, including the United States Food and Drug Administration (the "**FDA**"), Japan's Pharmaceuticals and Medical Devices Agency ("**PMDA**") and the European Medicines Agency ("**EMA**"), and any successors thereto, and (ii) any other relevant bodies authorized by Applicable Law to review or otherwise exercise oversight over MAAs, other regulatory filings or Regulatory Approvals.

1.89 "**Research Activities**" means the activities set forth in a Research Work Plan to be conducted by the Parties with respect to a Target or any Candidate Product pursuant to a Research Program during the Research Program Term for such Target or Candidate Product.

1.90 "**Research Program**" means, on a Target-by-Target basis, the program of discovery and pre-clinical activities undertaken for each Target as set forth in Article 2 and the Initial Research Work Plan attached as APPENDIX 1(a) hereto**,** and any Additional Research Work Plan(s) attached to this Agreement and incorporated herein after the Effective Date.

1.91 "**Research Program Milestone Event**" has the meaning set forth in Section 7.3.1(a).

1.92 "**Research Program Milestone Payment**" has the meaning set forth in Section 7.3.1(a).

1.93 "**Research Program Term**" has the meaning set forth in Section 2.1.3.

1.94 "**Research Quality Agreement**" has the meaning set forth in Section 2.7.1.

1.95 "**Research Work Plan**" means, collectively, the Initial Research Work Plan and any Additional Research Work Plans.

1.1 "**Results**" means, on a Target-by-Target, Candidate Product-by-Candidate Product or Product-by-Product basis, as applicable, all [***].

1.2 "**Royalty Term**" has the meaning set forth in Section 7.5.

1.3 "**Sales Milestone Event**" has the meaning set forth in Section 7.3.3.

1.4 "**Sales Milestone Payment**" has the meaning set forth in Section 7.3.3.

1.5 "**Sublicensees**" means any Third Party, including a co-development, co-promotion or co-marketing partner, to whom ALEXION or any of its Affiliates grants a sublicense of its rights hereunder to further Develop or Commercialize Products, but excluding service providers, clinical research organizations, manufacturers, wholesalers and other distributors.

1.6 "**Sublicensing Party**" has the meaning set forth in Section 10.2.5.

1.7 "**Target**" means the Initial Targets, any Additional Complement Pathway Target(s) for which ALEXION has exercised a Target Option in accordance with Section 2.6.2 and any replacement Targets designated pursuant to Section 2.2.2(b).

1.8 "**Target Option**" has the meaning set forth in Section 2.6.2.

1.9 "**Target Validation Activities**" means the activities set forth in the Target Validation Work Plan to be conducted by DICERNA with respect to the Additional Complement Pathway Targets.

1.10 "**Target Validation Work Plan**" has the meaning set forth in Section 2.6.1(a).

1.11 "**Taxes**" has the meaning set forth in Section 7.9.

1.12 "**Term**" has the meaning set forth in Section 13.1.

1.13 "**Territory**" means all of the countries of the world, and their territories and possessions.

1.14 "**Third Party**" means any person or entity other than ALEXION or DICERNA or their respective Affiliates.

1.15 "**Third Party Claim**" shall have the meaning as set forth in Section 12.1.

1.16 "**U.S. Prime Rate**" has the meaning set forth in Section 7.8.

1.17 "**Valid Claim**" means, with respect to a particular country, [***].

1.18 "**Voting Stock**" has the meaning set forth in Section 1.18(i).

2. RESEARCH PROGRAM

2.1 **Generally**.

2.1.1 **Goal**. With respect to each Target, the Parties agree to engage in the Research Program to identify and Develop Candidate Products directed to such Target as further described in the applicable Research Work Plan.

2.1.2 **Research Work Plan**. The Research Program for each Target shall be conducted in accordance with the applicable Research Work Plan. The Initial Research Work Plan for the Initial Targets agreed to by the Parties is attached hereto as APPENDIX 1(a), and any Additional Research Work Plans shall be approved by the JSC. The Parties may update and amend the Research Work Plans from time to time through the JSC, subject to Section 4.2.4.

2.1.3 **Research Program Term**. Each Research Program shall be performed, on a Target-by-Target and Candidate Product-by-Candidate Product basis, during the period commencing on the Effective Date (or in the case of the Additional Complement

Pathway Targets upon exercise of the corresponding Target Option) and expiring upon the earlier of (a) the date of the Development Decision Notice for the last Candidate Product for the applicable Target and (b) the expiration of the Evaluation Period for the last Candidate Product for the applicable Target, in each case unless (i) extended by ALEXION and agreed to by DICERNA, or (ii) earlier terminated as provided in Article 13 of this Agreement (the "**Research Program Term**").

2.2 **Stages of Research Program**

2.2.1 **Initial Discovery; Profiling**. DICERNA will be responsible for the discovery and initial profiling of the potential Candidate Products for each Target, including studies establishing [***] of the applicable Target in accordance with the applicable Research Work Plan.

2.2.2 **Delivery of Candidate Products; Candidate Product Report.**

(a) **Candidate Product Delivery.** On a Target-by-Target basis (including with respect to any Additional Complement Pathway Target for which ALEXION has exercised a Target Option pursuant to Section 2.6.2), DICERNA shall use diligent efforts to deliver to ALEXION Candidate Products that meet the Candidate Product Criteria set forth in the applicable Research Work Plan in accordance with the timeframes set forth therein, together with a report summarizing the Results for each Candidate Product within thirty [***] of the submission to ALEXION of each such Candidate Product.

(b) **Failure to Deliver Candidate Products.** On a Target-by-Target basis (including with respect to any Additional Complement Pathway Target for which ALEXION has exercised a Target Option pursuant to Section 2.6.2), in the event that DICERNA fails to deliver any Candidate Products to ALEXION within twelve (12) months following the commencement of the Research Program Term for such Target, ALEXION shall have the right to nominate a replacement Target from the list set forth on APPENDIX 2 and, effective as of such nomination (i) such replacement Target shall automatically be deemed a Target for all purposes under this Agreement and (ii) the replaced Target shall be deemed a Discontinued Target.

2.2.3 **Evaluation Period; Product Nomination**. On a Candidate Product-by-Candidate Product basis, ALEXION shall, in its sole discretion, make a determination as to whether such Candidate Product will be designated as a Product by providing to DICERNA a Development Decision Notice during the applicable Evaluation Period. Any and all costs associated with the evaluation of such Candidate Product by ALEXION during the applicable Evaluation Period shall be borne by ALEXION. Notwithstanding anything to the contrary in this Agreement, DICERNA shall keep ALEXION reasonably informed, through the JSC, regarding the status and progress of DICERNA's work on potential Candidate Products. For the avoidance of doubt, ALEXION may, at its sole election, deliver a Development Decision Notice notifying

DICERNA of its election to move such Candidate Product forward as a Product, regardless of whether such Candidate Product meets the Candidate Product Criteria set forth in the applicable Research Work Plan. On a Target-by-Target basis, if ALEXION has not delivered to DICERNA a Development Decision Notice notifying DICERNA of its election to move forward as a Product any Candidate Product directed to such Target by the end of the last Evaluation Period for a Candidate Product directed to such Target, then, upon either Party's election by written notice to the other Party, such Target shall be deemed a Discontinued Target.

2.3 **Research Program Costs**. [***].

2.4 **Reports**. During the Research Program Term for a particular Target, DICERNA shall compile written reports for such Target for which Research Activities are being conducted under the Research Program on a [***] basis to update ALEXION on the status of the activities being performed for such Target. The JSC will review such [***] update reports for such Target and confer regarding the progress towards the Candidate Product Criteria, review relevant data, consider and advise on any technical issues that arise, and consider issues of priority. Such reports must be sufficient in content to allow ALEXION to evaluate the progress of the Research Activities in relation to the requirements of the applicable Research Work Plan and the goals of the Research Program. In addition, DICERNA will provide to ALEXION such other information as may be required under any Research Work Plan or otherwise for the performance of the Research Program, and which is reasonably requested by ALEXION.

2.5 **Performance of Research Program**.

2.5.1 On a Target-by-Target basis, DICERNA will use diligent efforts to carry out each Research Program, complete all activities under each Research Work Plan and deliver the Candidate Products within the times agreed upon and set forth in the applicable Research Work Plan, with reasonable care and skill in accordance with all Applicable Laws and the provisions of this Agreement.

2.5.2 During each Research Program Term, DICERNA shall devote the efforts of suitably qualified and trained employees and research assistants capable of carrying out the activities set forth in the applicable Research Work Plan to a professional workmanlike standard and shall provide all necessary materials and facilities therefor.

2.5.3 DICERNA may not subcontract any of its Research Activities except with the prior written consent of ALEXION (such consent not to be unreasonably withheld, conditioned or delayed), and in compliance with the provisions of Section 10.2.5; provided that, ALEXION's consent shall not be required with respect to any subcontractor listed on Schedule 2.5.3, which list shall be provided for approval by ALEXION within [***] days after the Effective Date.

2.6 **Additional Complement Pathway Target Option(s)**.

2.6.1 **Target Validation**.

(a) **Target Validation Work Plan**. Upon ALEXION's written request, the JSC will prepare a work plan describing specific activities to be conducted by DICERNA, including activities will be directed towards validating certain Additional Complement Pathway Target(s) and providing ALEXION with sufficient data and information with respect to such Additional Complement Pathway Target(s) for ALEXION to exercise the Target Options (the "**Target Validation Work Plan**"). Such Target Validation Work Plan will include, at a minimum, a detailed timeline for the identification of such Additional Complement Pathway Target(s) and a budget for all activities described therein. The JSC may, from time to time, update the Target Validation Work Plan to include additional activities with respect to one or more Additional Complement Pathway Target(s), provided that any such additional Target Validation Activities beyond those set forth in the Target Validation Work Plan shall require DICERNA's prior written approval.

(b) **Performance of Target Validation Activities**.

(i) DICERNA will use diligent efforts to carry out the Target Validation Activities within the times agreed upon and set forth in the Target Validation Work Plan, with reasonable care and skill in accordance with all Applicable Laws and the provisions of this Agreement.

(ii) DICERNA shall devote the efforts of suitably qualified and trained employees and research assistants capable of carrying out the activities set forth in the Target Validation Work Plan to a professional workmanlike standard and shall provide all necessary materials and facilities therefor.

(iii) DICERNA may not subcontract any of its Target Validation Activities except with the prior written consent of ALEXION (such consent not to be unreasonably withheld, conditioned or delayed), and in compliance with the provisions of Section 10.2.5; provided that, ALEXION's consent shall not be required with respect to any subcontractor listed on Schedule 2.5.3, which list shall be provided for approval by ALEXION within thirty (30) days after the Effective Date.

(c) **Target Validation Costs; Payment**. For all Target Validation Activities with respect to an Additional Complement Pathway Target, ALEXION shall (i) pay DICERNA for FTE hours actually worked by DICERNA employees at the applicable FTE Rate, and (ii) reimburse DICERNA, on a non-refundable, non-reimbursable and non-creditable basis, for the direct materials and Third Party expenses incurred by DICERNA in performing the Target Validation Activities, in each case ((i) and (ii)), in accordance with budget set forth in

the applicable Target Validation Work Plan. DICERNA shall invoice ALEXION, and ALEXION shall pay DICERNA all amounts due under this Section 2.6.1(c) on a [***] basis within [***] days following ALEXION's receipt of the applicable Invoice therefor.

2.6.2 **Target Selection.** On an Additional Complement Pathway Target-by-Additional Complement Pathway Target basis, at any time starting on the Effective Date and ending on the later of (i) [***] days following the date that DICERNA completes the activities directed towards validating such Additional Complement Pathway Target as set forth in the Target Validation Work Plan, and (ii) [***] months after the Effective Date (the "**Option Period**"), ALEXION shall have the option to nominate any Additional Complement Pathway Target as a Target hereunder (each, a "**Target Option**"), provided that ALEXION may nominate no more than two (2) Additional Complement Pathway Targets unless the Parties otherwise agree in writing. ALEXION may exercise each Target Option by ALEXION by sending a written notice to DICERNA (each, an "**Option Exercise Notice**") of its election to exercise such Target Option, which Option Exercise Notice shall identify the applicable Additional Complement Pathway Target. The Research Program Milestone Events and corresponding Research Program Milestone Payments for such Additional Complement Pathway Target(s) shall be agreed upon by the JSC and shall be consistent with the Research Program Milestones for the Initial Targets in dollar amounts and time to achieve milestones and shall apply to any Additional Complement Pathway Target for which ALEXION exercises a Target Option, provided that such Research Program Milestone Payments shall not exceed [***] in the aggregate per Additional Complement Pathway Target.

2.6.1 **Target Option Exercise Fee**. Upon mutual agreement by the Parties of an Additional Research Work Plan through the JSC for an Additional Complement Pathway Target, ALEXION shall pay to DICERNA the Target Option exercise fee for such Additional Complement Pathway Target pursuant to Section 7.2. Upon payment of the Target Option exercise fee, such Additional Complement Pathway Target shall become a Target under this Agreement, and DICERNA shall promptly perform the obligations set forth in this Article 2.

2.7 **Research Quality Assurance; Research Quality Control**.

2.7.1 **Research Quality Agreement**. Within [***] days of the Effective Date, the Parties shall enter into a separate quality agreement that governs quality assurance and quality control activities and requirements with respect to the Research Program and the Target Validation Activities (the "**Research Quality Agreement**"), provided that such agreement shall specify that DICERNA will conduct all Research Activities and Target Validation Activities in accordance with quality standards agreed by the JSC within [***] days of the Effective Date and overseen by the JSC thereafter.

2.8 **Exclusivity**.

2.8.1 **DICERNA Exclusivity**. During the applicable Exclusivity Period, DICERNA shall not, either alone or with any Third Party, research, Develop, Manufacture, use, sell, offer for sale, import, or Commercialize any protein, antibody, small molecule compound or other biological molecule, chemical molecule or other molecule that directly binds to or targets any Target or Additional Complement Pathway Target.

2.8.2 **ALEXION Exclusivity**. During the applicable Exclusivity Period, ALEXION shall not, either alone or with any Third Party, research, Develop, Manufacture, use, sell, offer for sale, import or Commercialize a product directed to any Target hereunder using siRNA technology, other than a Candidate Product or a Product.

1. INITIAL DEVELOPMENT PERIOD

1.1 **Generally**.

1.1.1 **Development Plan**. On a Product-by-Product basis, within [***] days following the delivery of a Development Decision Notice with respect to any Candidate Product for which ALEXION elects to continue Development, the JSC shall prepare a draft development plan setting forth the specific activities to be conducted by DICERNA for such Product during the Initial Development Period, including those Development Activities set forth in APPENDIX 1(b) hereto (the "**Development Plan**"), which Development Plan shall be attached hereto as APPENDIX 3.

1.1.2 **Initial Development Period**. The Development Program shall be performed, on a Product-by-Product basis, during the period commencing on the expiration of the Research Program Term for such Product and ending upon the Initiation of a Phase I Clinical Trial for such Product, unless earlier terminated by ALEXION in its sole discretion (the "**Initial Development Period**").

1.1.3 **Development Plan Activities**. With respect to a Product, during the corresponding Initial Development Period, DICERNA shall conduct the Development Activities in accordance with the Development Plan for a Product. Such Development Activities shall include pre-clinical toxicology, IND-enabling studies and reasonable assistance to ALEXION in the IND filing preparation. DICERNA shall devote (or reserve, as applicable) such internal resources as are necessary to perform all Development Activities set forth in the applicable Development Plan.

1.1.4 **Deliverables**. Promptly following completion of a Development Activity, DICERNA shall deliver to ALEXION any and all Deliverables for such Development Activity for such Product as set forth in the applicable Development Plan in accordance with the criteria set forth therein.

1.1.5 **Initial Development Period Costs**. [***].

1.2 **Performance of Development Program**.

1.2.1 On a Product-by-Product basis, DICERNA will use diligent efforts to carry out the Development Program, complete the Development Activities under each Development Plan and deliver the Deliverables to ALEXION within the times agreed upon and set forth in the Development Plan, with reasonable care and skill in accordance with all Applicable Laws and the provisions of this Agreement.

1.2.2 During the Initial Development Period, DICERNA shall devote the efforts of suitably qualified and trained employees and research assistants capable of carrying out the activities set forth in the Development Plan to a professional workmanlike standard and shall provide all necessary materials and facilities therefor.

1.2.3 DICERNA may not subcontract any of its Development Activities except with the prior written consent of ALEXION (such consent not to be unreasonably withheld, conditioned or delayed), and in compliance with the provisions of Section 10.2.5; provided that, ALEXION's consent shall not be required with respect to any subcontractor listed on Schedule 2.5.3, which list shall be provided for approval by ALEXION within [***] days after the Effective Date.

1.3 **Development Quality Assurance; Development Quality Control**.

1.3.1 **Development Quality Agreement**. Within [***] days following the delivery of a Development Decision Notice with respect to the first Candidate Product for which ALEXION elects to continue Development, the Parties shall enter into a separate quality agreement that governs quality assurance and quality control activities and requirements with respect to the Development Activities (the "**Development Quality Agreement**"), which agreement shall specify that DICERNA will conduct all Development Activities in accordance with GCP and Good Pharmacovigilance Practices.

1.3.2 **Inspection and Auditing Rights**. [***].

2. GOVERNANCE

2.1 **Collaboration Management**.

2.1.1 **Research Program Leaders**. Each Party will appoint a single individual to act as a point of contact between the Parties to support the Target Validation Activities, the Research Programs and the Development Programs (the "**Program Leaders**"). The initial Program Leaders shall be set forth in APPENDIX 4 – Title: "Contact List" hereto. Either Party may change the person designated as Program Leader upon written notice (including via email notification) to the other Party, provided that such new Program Leader possesses sufficient alliance management experience and is otherwise suitably qualified.

2.1.2 **Roles and Responsibilities**. The Program Leaders will be responsible for (i) facilitating the flow of information and otherwise promoting communication of the

day-to-day work for the Target Validation Activities and each Research Program and Development Program, (ii) coordinating the Target Validation Activities and all work to be conducted under each Research Program and Development Program, and (iii) all scientific and technical questions addressed by one Party to the other Party. The Program Leaders shall conduct regular telephone conferences every four (4) weeks, or more frequently as deemed necessary or appropriate by the Parties, to exchange information regarding the progress of each research project under and according to the applicable Research Work Plan and applicable Development Plan.

2.2 **Governance.**

2.2.1 **Joint Steering Committee**. Within [***] days after the Effective Date of this Agreement, the Parties shall establish a joint steering committee to oversee (a) the Target Validation Work Plan, (b) the Research Work Plan during the Research Program Term with respect to each Target and (b) the Development Plan during the Initial Development Period with respect to each Candidate Product for which ALEXION has delivered a Development Decision Notice (the "**Joint Steering Committee**" or "**JSC**") comprised of at least [***] of ALEXION and at least [***] of DICERNA, which representatives of DICERNA shall include, at a minimum, DICERNA's chief scientific officer. Either Party may replace its representatives at any time upon prior written notice to the other Party. Subject to (i) the prior written consent of the other Party, (ii) a written non-conflict of interest statement of any individual invited by a Party but not employed by such Party, and (iii) execution of a confidentiality agreement, either Party may invite non-voting employees and, as approved in advance by the other Party, which approval shall not be unreasonably withheld, consultants or scientific advisors to attend meetings of the JSC and to review and discuss the Target Validation Activities, the Research Program and the Development Program.

2.2.2 **Meetings**. The JSC will meet in person (alternating between a site designated by each of DICERNA and ALEXION) or by teleconference at least once every Calendar Quarter, or with such other frequency as the Parties may mutually agree. Specific meeting dates will be defined by mutual agreement of the Parties.

2.2.3 **Responsibilitie**s. The JSC shall oversee the Target Validation Activities, the Research Programs and the Development Programs. Within such scope the JSC shall, subject to Section 4.2.4 and Section 4.2.5:

(a) review the efforts and the progress of the Parties in the conduct of the Target Validation Activities, the Research Programs and the Development Programs;

(b) review and amend the Research Work Plans and the Development Plans;

(c) prepare and amend the Target Validation Work Plan;

(d) consider and advise on any technical or safety issues that arise under the Target Validation Activities, the Research Programs or the Development Programs;

(e) review DICERNA's [***] update reports to ALEXION on the status of the Research Activities being performed for each Target,

(f) form such other committees as the JSC may deem appropriate, provided that such committees may make recommendations to the JSC but may not be delegated JSC decision-making authority;

(g) attempt to resolve any disputes on an informal basis; and

(h) address such other matters relating to the Target Validation Activities, the Research Activities and the Development Activities as either Party may bring before the JSC.

2.2.4 **Decision Making Authority**. A quorum for a meeting of the JSC shall require the presence of at least one (1) representative from each Party. The JSC shall endeavor to reach decisions by consensus, with each Party, through its representative members of the JSC, having one (1) vote. [***].

2.2.5 **Limits on JSC Decision Making Authority**. Neither Party shall have the authority to make any decision without the consent of the other Party that would result in a material increase in the other Party's costs or expenses under this Agreement, the Target Validation Work Plan or any Research Work Plan or Development Plan. Notwithstanding the foregoing, the JSC shall have the right to, on a plan-by-plan basis, implement one or more Changes to any given Research Work Plan, Development Plan or Target Validation Work Plan; provided that [***]. Further, except as expressly set forth herein, the JSC shall not have the power to amend the terms of, or waive compliance with, this Agreement.

2.3 **Disbandment of the JSC**. Upon expiration (or earlier termination) of the last Initial Development Period for the last Product, the JSC will have a final meeting to review the results of the overall collaboration and will thereafter be disbanded, and will have no further authority with respect to the activities hereunder.

3. DEVELOPMENT, REGULATORY APPROVALS AND COMMERCIALIZATION

3.1 **Technology Transfer**. In addition to the information, data and materials exchanged between the Parties through the JSC, on a Product-by-Product basis, within [***] days after the conclusion of the Initial Development Period, DICERNA shall transfer to ALEXION a technology transfer package that includes all data, information, materials and samples [***] for ALEXION to practice the license granted under Section 10.2.4 at ALEXION's cost and expense.

3.2 **Development**. Following the conclusion of the Initial Development Period, ALEXION shall have sole control over, shall bear all costs and expenses of, and shall have sole discretion and decision-making authority with respect to, the Development of the Products.

3.3 **Regulatory Activities**. ALEXION shall have sole control over, will own and control, and will bear all costs and expenses of, preparing and submitting applications for and obtaining and maintaining Regulatory Approvals for Products, including the filing of INDs for Products and communications with Regulatory Authorities; provided that, ALEXION shall consult with DICERNA with respect to the DICERNA GalXC Technology and consider in good faith DICERNA's comments and recommendations. DICERNA will provide reasonable cooperation in the event that information Controlled by DICERNA is needed for any such application or communication and provided further, that ALEXION reimburses DICERNA at the FTE Rate for the time and expenses incurred by DICERNA to provide such cooperation.

3.4 **Commercialization**. ALEXION shall have sole control over, shall bear all costs and expenses of, and shall have sole discretion and decision-making authority with respect to, the Commercialization of Products.

3.5 **Diligence**.

3.5.1 **Development Diligence**. ALEXION will use Commercially Reasonable Efforts to Develop and seek Regulatory Approval for [***]. ALEXION will have no other diligence obligations with respect to the Development or Regulatory Approval of Products under this Agreement.

3.5.2 **Commercial Diligence**. ALEXION will use Commercially Reasonable Efforts to Commercialize a given Product in [***]. ALEXION will have no other diligence obligations with respect to the Commercialization of Products under this Agreement.

3.5.3 **Deemed Satisfaction of ALEXION Diligence Obligations**. Without in any way expanding ALEXION's obligations under this Agreement, ALEXION's expenditure of at least [***] (including internal costs) during any Calendar Year directly allocable to the Development, Regulatory Approval, or Commercialization of [***] Products directed to a Target will be conclusive evidence that ALEXION has satisfied all ALEXION diligence obligations under this Agreement for such Calendar Year.

3.6 **Other ALEXION Programs**. Subject to Section 2.8.2, DICERNA understands and acknowledges that ALEXION may have present or future initiatives or opportunities, including initiatives or opportunities with its Affiliates or Third Parties, involving products, programs, technologies or processes that are similar to, and in some instances may compete with, a Product, program, technology or process covered by this Agreement. Subject to Section 2.8.2, DICERNA acknowledges and agrees that nothing in this Agreement will be construed as a representation, warranty or covenant that ALEXION will not itself Develop, Manufacture or Commercialize or enter into business relationships with one (1) or more of its Affiliates or Third Parties to Develop, Manufacture or Commercialize, products,

programs, technologies or processes that are similar to or that may compete with any product, program, technology or process covered by this Agreement, provided that, for clarity, ALEXION will not use DICERNA's Confidential Information in breach of this Agreement.

3.7 **DICERNA Support**. The Parties understand and agree that it may be necessary for ALEXION from time to time to seek guidance from DICERNA following the Initial Development Period, and DICERNA hereby agrees to provide such guidance as a consultant upon the request of ALEXION at the applicable FTE Rate and subject to reimbursement of DICERNA's reasonable out-of-pocket expenses. DICERNA shall invoice ALEXION, and ALEXION shall pay DICERNA all amounts due under this Section 5.7 within [***] days following receipt of the applicable Invoice.

4. MANUFACTURING

4.1 **Generally**. DICERNA shall supply each Product through the completion of Phase I Clinical Trials for such Product in accordance with Section 6.2, either itself or through a CMO, provided that [***], and ALEXION shall pay DICERNA for such supply at a cost equal to [***]. On a Product-by-Product basis, following (a) conclusion of the Phase I Clinical Trial for such Product, and (b) successful Manufacturing technology transfer as set forth in Section 6.4 for such Product, ALEXION shall have sole responsibility for, and sole decision-making authority with respect to, all Manufacturing activities and associated costs and expenses for the Manufacture of Products.

4.2 **Phase I Clinical Trial Supply**.

4.2.1 **Supply Agreement**. DICERNA (or its CMO, subject to Section 6.1) shall Manufacture and supply pre-clinical and Phase I Clinical Trial supply of each Product, and within [***] days following the Effective Date, the Parties shall execute a supply agreement containing mutually agreed supply terms and conditions consistent with the principles set forth on Schedule 6.2.1 hereto and typical for such agreements (the "**Supply Agreement**").

4.2.2 **Observation**. [***].

4.3 **Quality Assurance; Quality Control**.

4.3.1 **Quality Agreement**. Simultaneously with entry into the Supply Agreement, the Parties shall enter into a separate quality agreement that governs quality assurance and quality control activities and requirements with respect to the supply of Candidate Products and Products in the Territory, which agreement shall contain terms and conditions typical for such agreements (the "**Quality Agreement**"). The Quality Agreement shall specify that (i) [***].

4.3.2 **Inspection and Auditing Rights**. [***].

4.4 **Manufacturing Technology Transfer**. In addition to the initial technology transfer set forth in Section 5.1 hereto, on a Product-by-Product basis, upon ALEXION's reasonable request, the Parties shall develop and agree upon a Manufacturing technology transfer plan (the "**Manufacturing Tech Transfer Plan**") which will include all activities necessary to enable ALEXION (or a CMO designated by ALEXION) to Manufacture the applicable Product. The Parties will complete the Manufacturing Tech Transfer Plan for each Product [***] as quickly as possible following mutual agreement thereof, but in any event within [***] prior to the anticipated Initiation of the applicable Phase II Clinical Trial. Thereafter during the Term, at least every [***], DICERNA will transfer to ALEXION any Manufacturing Know-How that has arisen since the previous Manufacturing Know-How transfer (or deliver to ALEXION a certified statement that no such Manufacturing Know-How has arisen during the applicable period) to continue to enable ALEXION to Manufacture the Products [***].

4.5 **DICERNA Support**. The Parties understand and agree that it may be necessary for ALEXION from time to time to seek guidance from DICERNA following the technology transfer contemplated by Section 6.4 above, including with respect to scale-up activities, and DICERNA hereby agrees to provide such guidance as a consultant upon the reasonable request of ALEXION at the applicable FTE Rate and subject to reimbursement of DICERNA's reasonable out-of-pocket expenses. DICERNA shall invoice ALEXION, and ALEXION shall pay DICERNA all amounts due under this Section 6.5 within [***] following receipt of the applicable Invoice.

5. PAYMENTS AND ROYALTIES

5.1 **One-time Upfront Payment; Equity Investment**.

5.1.1 **Upfront Payment**. ALEXION shall pay to DICERNA, within [***] Business Days of the Effective Date, a one-time, non-refundable, non-reimbursable and non-creditable upfront payment of Twenty-Two Million Dollars ($22,000,000).

5.1.2 **Equity Investment**. As of the Effective Date, the Parties have entered into a Share Issuance Agreement, pursuant to which ALEXION will purchase shares of DICERNA PHARMA's Common Stock .

5.2 **Target Option Exercise Fee**. On an Additional Complement Pathway Target-by-Additional Complement Pathway Target basis, within [***] Business Days of delivery of an Option Exercise Notice by ALEXION to DICERNA in accordance with Section 2.6.2, ALEXION shall pay to DICERNA a one-time non-refundable, non-reimbursable and non-creditable payment of Ten Million Dollars ($10,000,000). For the avoidance of doubt, if ALEXION elects to exercise the Target Option for two (2) Additional Complement Pathway Targets pursuant to Section 2.1.1 above, ALEXION shall pay to DICERNA an aggregate amount of Twenty Million Dollars ($20,000,000) pursuant to this Section 7.2.

5.3 **Milestone Payments**.

5.3.1 **Research Program Milestones**.

(a) On a Target-by-Target basis, ALEXION shall pay to DICERNA the non-refundable, non-creditable milestone payments for such Target (each, a "**Research Program Milestone Payment**"), as specified in APPENDIX 1(b) for the Initial Targets (and as agreed by the JSC for each Additional Complement Pathway Target) upon the achievement of the corresponding milestone events for such Target set forth in APPENDIX 1(b) for the Initial Targets (and as agreed by the JSC for each Additional Complement Pathway Target) (each, a " **Research Program Milestone Event**") and in accordance with the provisions of this Article 7. Each Research Program Milestone Payment shall be payable only once per Target for the achievement of the applicable Research Program Milestone Event for such Target.

(b) DICERNA shall, within [***] days after DICERNA becomes aware of the achievement of any Research Program Milestone Event, provide ALEXION with a written notice of the achievement of such Research Program Milestone Event and an Invoice related to the respective Research Program Milestone Payment. Each of the Research Program Milestone Payments shall be payable to DICERNA by ALEXION within [***] days of the receipt of such corresponding Invoice.

5.3.2 **Development Milestones**. On a Target-by-Target basis, ALEXION shall make one-time non-refundable milestone payments (each, a "**Development Milestone Payment**") to DICERNA upon the first occurrence of each of the development milestones events set forth below in this Section 7.3.2 (each, a "**Development Milestone Event**") for the first Product directed to such Target to achieve such Development Milestone Event. For the avoidance of doubt, each Development Milestone Payment hereunder shall be payable only once per Target upon the first achievement of the applicable Development Milestone Event by a Product directed to such Target. No additional Development Milestone Payments shall be made for any subsequent achievement of such Development Milestone Event by any subsequent Product for the same Target. In the event that one (1) or more Development Milestone Events are skipped for a Product, such skipped Development Milestone Events shall be payable upon achievement of the subsequent Development Milestone Event, except that a Development Milestone Event in one (1) territory shall not be deemed to be skipped solely because a subsequent Development Milestone Event was achieved in a different territory (e.g., a First Commercial Sale in Japan shall not be deemed to trigger a Development Milestone Payment for a First Commercial Sale in the United States or a Major European Market if such First Commercial Sale has not yet occurred in the United States or a Major European Market). ALEXION shall, within [***] days after ALEXION becomes aware of the achievement of a Development Milestone Event, notify DICERNA in writing that such Development Milestone Event has occurred, and DICERNA shall provide ALEXION with an Invoice related to the respective Development Milestone Payment. Each of the Development Milestone Payments shall be payable to DICERNA by ALEXION within [***] days of the receipt of such corresponding

Invoice, regardless of whether achieved by or on behalf of ALEXION or its Affiliates or Sublicensees. The maximum amount payable by ALEXION with respect to a given Target under this Section 7.3.2 if all Development Milestone Events occur (regardless of the number of times they occur or the number of Products that trigger them) is One Hundred Five Million Dollars ($105,000,000).

Development Milestone Event	Development Milestone Payment
[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]

5.3.3 **Sales Milestones**. ALEXION shall make one-time non-refundable sales milestone payments (each, a "**Sales Milestone Payment**") to DICERNA upon the occurrence of each of the sales-based milestones events (each, a "**Sales Milestone Event**") set forth below in this Section 7.3.3. For the avoidance of doubt, each of the Sales Milestone Payments set forth below shall be payable only one time, for the first Calendar Year in which the corresponding Sales Milestone Event is achieved, provided that, if more than one Sales Milestone Event is achieved in a single Calendar Year, only the greater of the Sales Milestone Payment for all Sales Milestone Events achieved in such Calendar Year shall be due, and any skipped or otherwise unpaid Sales Milestone Event shall remain in full force and effect, such that any subsequent achievement of any skipped Sales Milestone Event shall be treated as though such subsequent achievement was the first achievement of such Sales Milestone Event. Each Sales Milestone Payment shall be paid within [***] days of the end of the [***] in which such Sales Milestone Event is payable pursuant to the preceding sentence.

Sales Milestone Event	Sales Milestone Payment
[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]

5.4 **Royalties**. Subject to the provisions of Section 7.7, ALEXION shall pay to DICERNA royalties in the amount of the Marginal Royalty Rates (set forth below) of the aggregate Net Sales resulting from the sale of Products, on a Product-by-Product basis, in the Territory during each Calendar Year of the applicable Royalty Term for each Product (each, the " **Per Product Annual Net Sales**").

Per Product Annual Net Sales	Marginal Royalty Rate (% of Per Product Annual Net Sales)
The portion of Per Product Annual Net Sales less than [***]	[***]
The portion of Per Product Annual Net Sales greater than or equal to [***] but less than [***]	[***]
The portion of Per Product Annual Net Sales greater than or equal to [***] but less than [***]	[***]
The portion of Per Product Annual Net Sales greater than or equal to [***] but less than [***]	[***]
The portion of Per Product Annual Net Sales greater than or equal to [***] but less than [***]	[***]
The portion of Per Product Annual Net Sales greater than [***]	[***]

Each Marginal Royalty Rate set forth in the table above shall apply only to that portion of the Net Sales of a given Product in the Territory during a given Calendar Year that falls within the indicated range. An example calculation of royalties under this Section 7.4 is set forth in APPENDIX 6.

5.5 **Royalty Term**. ALEXION's obligation to pay royalties shall begin, on a country-by-country and Product-by-Product basis, with the First Commercial Sale of such Product in such country, and shall expire, on a country-by-country and Product-by-Product basis, upon the latest of (i) expiration of the last-to-expire Valid Claim of any Licensed Patent Right or Product Patent Right Covering such Product in such country, (ii) the expiration of market or regulatory exclusivity for such Product in such country, or (iii) ten (10) years following

the date of First Commercial Sale of the first Product in such country (the "**Royalty Term**"). Upon expiration (but not earlier termination) of the Royalty Term for a given Product in a given country (a) no further royalties shall be payable in respect of sales of such Product in such country, and (b) the licenses granted to ALEXION under Section 10.2.3 with respect to such Product in such country shall automatically become fully paid-up, perpetual, irrevocable and royalty free. For the sake of clarity, no multiple royalties shall be payable because more than one Valid Claim is applicable to a Product, its Manufacture, use or sale during the Royalty Term.

5.6 **Royalty Reports; Payments**.

5.6.1 **Royalty Reports**. Within [***] days following the end of each [***] during which any royalty payments are owed, ALEXION shall submit to DICERNA a written report of Net Sales of Products sold, in the currency for which such Products were sold (and, if the currency of sale was not Dollars, also in Dollars), by or on behalf of ALEXION, its Affiliates and Sublicensees during such [***], and the royalty payments payable on such Net Sales in sufficient detail to permit confirmation of the accuracy of royalty payments paid hereunder.

5.6.2 **Royalty Payments.** Royalties will be payable on a [***] basis and any such payments shall be made within [***] days after the end of the [***] during which the applicable Net Sales of Products occurred.

5.6.3 **Payment Method**. All payments to be made between the Parties under this Agreement shall be made in Dollars and may be paid by wire transfer, or electronic funds transfer in immediately available funds to a bank account designated by DICERNA or ALEXION, as applicable.

5.6.1 [***].

5.6.2 **Currency Conversion**. With respect to sales of Products invoiced in United States Dollars, all such amounts shall be expressed in United States Dollars. With respect to sales of Products invoiced in a currency other than United States Dollars, all such amounts shall be expressed both in the currency in which the sale is invoiced and in the United States Dollar equivalent. All royalties payable hereunder shall be calculated based on ALEXION Net Sales expressed in United States Dollars. For purposes of this Section 7.6.5, the United States Dollar equivalent shall be calculated using the rate of exchange at the close of business on the date ALEXION records the net revenue from the ALEXION customer. Each daily exchange rate will be obtained from Bloomberg or, if not so available, as otherwise agreed by the Parties.

5.1 **Royalty Adjustments**.

5.1.1 **Generic Competition**. In the event that there is Generic Competition with respect to a Product in a country during a [***], then royalties payable by ALEXION pursuant to Section 7.4 for such Product in such country shall be reduced by [***] percent

[***] for such [***] and the remainder of the Royalty Term for such Product in such country.

5.1.2 **Third Party Royalties Offset**. In the event that ALEXION enters into an agreement with a Third Party to obtain a license under a Patent Right or other intellectual property right owned or controlled by such Third Party that is [***] a Product in a country, then [***] due to DICERNA pursuant to Section 7.4 for the respective Product in such country shall be reduced by [***] percent [***] of [***] paid to such Third Party in respect of such agreement.

5.1.3 **No Valid Claim**. During the applicable Royalty Term for a Product in a country, if such Product is sold in such country and is not Covered by a Valid Claim of any Licensed Patent Right or Product Patent Right in such country at the time of such sale, then the royalties payable pursuant to Section 7.4 for such Product in such country shall be reduced by [***] percent [***].

5.1.4 **Maximum Royalty Adjustments**. For clarity, in no event shall the royalties payable to DICERNA in a country, as reduced by Sections 7.7.1 – 7.7.3 above be reduced to less than [***] percent [***] of annual Net Sales of a Product in a country. ALEXION may carry forward any such reductions permitted under Sections 7.7.1- 7.7.3 that are incurred or accrued in a [***] but are not applied against royalties due to DICERNA for such Product in such country in such [***] as a result of the foregoing floor and apply such amounts against royalties due to DICERNA for such Product in such country in any subsequent [***] (subject to the minimum floor set forth in this Section 7.7.4) until the amount of such reduction has been fully applied against royalties due to DICERNA for such Product in such Country.

5.1.5 **DICERNA Third Party Agreements**. [***].

5.2 **Late Payments**. If ALEXION fails to make any undisputed payment due under this Agreement as provided herein on or before the date that such payment is due, then the amount of such payment will bear interest at an annual rate equal to the lesser of (i) [***] or (ii) the maximum rate permitted by Applicable Law, in each case, [***].

5.3 **Taxes**. All payments under or in connection with this Agreement shall be inclusive of any Taxes and each Party shall be responsible for and shall bear, pay or set-off its own Taxes assessed by a tax or other authority except as otherwise set forth in this Agreement. "**Taxes**" shall mean all forms of preliminary or finally imposed taxation, domestic and foreign taxes, fees, levies, duties and other assessments or charges of whatever kind (including sales, use, excise, stamp, transfer, property, value added, goods and services, withholding and franchise taxes) together with any interest, penalties or additions payable in connection with such taxes, fees, levies duties and other assessments or charges.

5.4 **Withholding Taxes**. If Applicable Law requires withholding by ALEXION and/or its Affiliates of any Taxes imposed upon DICERNA and/or its Affiliates on account of any royalties and other payments paid under this Agreement for the benefit of DICERNA and/

or its Affiliates, such Taxes shall be retained by ALEXION and/or its Affiliates as required by such Applicable Law from such remittable royalty and other payment and shall be timely remitted by ALEXION and/or its Affiliates to the proper Tax authorities on behalf of DICERNA and/or its Affiliates. Official receipts of the remittance by ALEXION and/or its Affiliates of any such withholding Tax shall be reasonably promptly secured and sent by ALEXION and/or its Affiliates to DICERNA and/or its Affiliates as evidence of such payment. The Parties shall cooperate and exercise their reasonable best efforts to ensure that any withholding Taxes imposed on DICERNA and/or its Affiliates are reduced as far as possible under the provisions of any Applicable Law. Notwithstanding the foregoing, the Parties acknowledge and agree that (i) under Applicable Law as of the date hereof, no amounts shall be withheld in respect of royalties or other amounts required to be paid by ALEXION and/or its Affiliates to DICERNA and/or its Affiliates pursuant to this Agreement and (ii) (A) if a change to a Party's payment allocation procedures pursuant to Section 7.6.4 or (B) a Party's redomiciliation to (or assignment of this Agreement to an entity resident for purposes of an applicable Tax treaty in) a jurisdiction other than the jurisdiction in which such Party is resident for such purposes as of the date of this Agreement (but not, for the avoidance of doubt, a change in Applicable Law), in either case ((A) and (B)), leads to the imposition of withholding Tax liability on the other Party 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, then such Party will reimburse the other Party for any such additional or increased withholding Tax liability (except to the extent that the other Party can reclaim it, provided that the other Party will be reimbursed for any reasonable out of pocket costs incurred in the reclaim).

5.5 **Financial Audits**.

5.5.1 **Audits by DICERNA**. [***].

5.5.2 **Audits by ALEXION**. [***].

6. REPRESENTATIONS, WARRANTIES AND COVENANTS

6.1 **Mutual Representations, Warranties and Covenants of the Parties**. Each Party represents and warrants to the other Party as of the Effective Date, and as applicable, covenants to the other Party, that:

6.1.1 it is validly existing and in good standing under the Applicable Laws of the jurisdiction of its incorporation and has the full right, power and authority to enter into this Agreement, conduct the activities allocated to it under this Agreement, grant the licenses and assign the rights under this Agreement and disclose such information and Know-How that is disclosed in performance of its obligations under this Agreement;

6.1.2 this Agreement has been duly executed by it and is legally binding upon it, enforceable in accordance with its terms, and does not conflict with any agreement, instrument or understanding, oral or written, to which it is a party or by which it may

be bound, nor violate any material Applicable Law of any court, governmental body or administrative or other agency having jurisdiction over it;

6.1.3 neither it, nor any of its Affiliates are party to any agreements, oral or written, that conflict with its obligations under this Agreement; and

6.1.4 neither it, nor any of its Affiliates, have been Debarred, and during the Term, neither it, nor any of its Affiliates shall use, in any capacity in connection with the obligations to be performed under this Agreement, any person or entity who has been Debarred.

6.2 **Additional Representations and Warranties of DICERNA**. DICERNA represents and warrants to ALEXION as of the Effective Date that:

6.2.1 all Licensed Patent Rights existing as of the Effective Date are set forth on APPENDIX 5 hereto, and all Licensed Patent Rights included therein (i) with respect to Licensed Patent Rights that are issued Patent Rights, are valid and enforceable, (ii) are being diligently prosecuted in the respective patent offices in the Territory in accordance with Applicable Law, and (iii) have been filed and maintained properly and correctly and all applicable fees have been paid on or before the due date for such payments;

6.2.2 during the Term, DICERNA shall ensure that all laboratories, rooms and equipment and the conduct of all activities to be carried out by on behalf of DICERNA in connection with the Target Validation Activities, the Research Programs or the Development Programs, comply with the Research Work Plans, the Development Plans, and Applicable Laws (including, as applicable GLP and GCP);

6.2.3 DICERNA is the sole and exclusive owner of, or Controls, the DICERNA GalXC Technology and the Licensed Intellectual Property licensed by DICERNA to ALEXION under this Agreement;

6.2.4 DICERNA has the necessary rights to the Licensed Intellectual Property and the DICERNA GalXC Technology licensed to ALEXION under this Agreement to conduct the Target Validation Activities, the Research Programs and the Development Programs in the manner contemplated under the applicable Research Work Plans and Development Plans;

6.2.5 neither DICERNA, nor any of its Affiliates have previously assigned, transferred, conveyed or otherwise encumbered its right, title or interest in or to the DICERNA GalXC Technology, the Licensed Intellectual Property or the Product IP in a manner that would prevent (i) DICERNA from performing the Target Validation Activities in accordance with the Target Validation Work Plan, the Research Activities in accordance with the Research Work Plans or the Development Activities in accordance with the Development Plans, or assigning and granting the rights to ALEXION set forth in Section 10; or (ii) ALEXION or its Affiliates, subcontractors and Sublicensees from researching, Developing, Manufacturing or Commercializing

Products or from otherwise exploiting its rights and licenses granted or assigned by DICERNA hereunder;

6.2.6 other than [***], there are no pending claims, judgments or settlements against, or amounts owed to a Third Party by DICERNA or any of its Affiliates in connection with a claim, judgment or settlement, involving Licensed Intellectual Property or the DICERNA GalXC Technology licensed by DICERNA to ALEXION under this Agreement and DICERNA has not received written notice threatening any such claims, judgments or settlements;

6.2.7 to DICERNA's knowledge, all information disclosed to ALEXION by DICERNA relating to the DICERNA GalXC Technology, the Licensed Intellectual Property and the materials and methods to be employed by DICERNA in the execution of the Research Work Plan and this Agreement is, at the time of disclosure, accurate in all material respects;

6.2.8 to DICERNA's knowledge, no person is infringing or threatening to infringe or misappropriate or threatening to misappropriate the Licensed IP;

6.2.9 each person who has or has had any rights in or to any Licensed IP existing as of the Effective Date and owned by DICERNA has assigned and has executed an agreement assigning its entire right, title and interest in and to such Licensed IP to DICERNA and, to DICERNA's knowledge, each person who has or has had any rights in or to any Licensed IP existing as of the Effective Date and licensed to DICERNA by a Third Party has assigned and has executed an agreement assigning its entire right, title and interest in and to such Licensed IP to such Third Party;

6.2.10 it is entitled to grant the licenses and assign the rights according to Article 10 below to ALEXION, and that it has taken all appropriate measures (including having appropriate agreements in place with any person or contractor that will be involved in the Target Validation Activities, Research Activities or Development Activities) under all Applicable Laws to grant such licenses and assign such rights;

6.2.11 other than the Intellectual Property that is licensed or assigned by DICERNA to ALEXION in this Agreement and as disclosed in Section 8.2.6, DICERNA is not aware and has not received any written notice of any Intellectual Property (including any Intellectual Property Controlled by a Third Party) that would be infringed, either by ALEXION or DICERNA, in the course of conducting the Target Validation Activities, Research Activities or Development Activities, or ALEXION's use, Manufacture, Commercialization or other exploitation of any Candidate Product or Product; and

6.2.12 [***].

6.1 **Covenants**. Each Party shall, and shall ensure that its Affiliates and Sublicensees, obtain written agreements from any and all persons involved in or performing any Target Validation

Activities, any Research Activities or any Development Activities assigning such persons' right, title and interest in and to any New Inventions, Licensed IP, Results, GalXC Foreground IP or Product IP to such Party prior to any such person performing such activities. During the Term, DICERNA shall maintain sufficient resources to perform the Target Validation Activities, the Research Activities and the Development Activities in accordance with this Agreement. Neither DICERNA, nor any of its Affiliates, shall assign, transfer, convey or other encumber during the Term, its right, title or interest in or to the DICERNA GalXC Technology, the Licensed Intellectual Property or the Product IP in a manner that would prevent (i) DICERNA from performing the Target Validation Activities in accordance with the Target Validation Work Plan, the Research Activities in accordance with the Research Work Plans or the Development Activities in accordance with the Development Plans, or assigning and granting the rights to ALEXION set forth in Section 10; or (ii) ALEXION or its Affiliates, subcontractors and Sublicensees from researching, Developing, Manufacturing or Commercializing Products or from otherwise exploiting its rights and licenses granted or assigned by DICERNA hereunder.

6.2 **DISCLAIMER OF WARRANTIES**. EXCEPT AS OTHERWISE EXPRESSLY SET FORTH HEREIN, NEITHER PARTY MAKES ANY REPRESENTATION OR EXTENDS ANY WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF TITLE, NON-INFRINGEMENT, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN PARTICULAR, NEITHER PARTY MAKES ANY REPRESENTATION OR EXTENDS ANY WARRANTY THAT THE CANDIDATE PRODUCTS OR PRODUCT(S) WILL BE SUCCESSFULLY DEVELOPED HEREUNDER.

6.3 **NO CONSEQUENTIAL DAMAGES**. EXCEPT FOR DAMAGES RESULTING FROM BREACHES OF SECTION 2.8 (EXCLUSIVITY) OR ARTICLE 9 (CONFIDENTIALITY), OR INDEMNIFIABLE CLAIMS UNDER ARTICLE 12 (INDEMNIFICATION), IN NO EVENT WILL EITHER PARTY HAVE ANY CLAIMS AGAINST OR LIABILITY TO THE OTHER PARTY WITH RESPECT TO ANY INDIRECT, PUNITIVE, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING ANY CLAIMS FOR LOST PROFITS OR REVENUES) ARISING UNDER OR IN CONNECTION WITH THIS AGREEMENT UNDER ANY THEORY OF LIABILITY, EVEN IF SUCH PARTY HAS BEEN INFORMED OR SHOULD HAVE KNOWN OF THE POSSIBILITY OF SUCH DAMAGES.

7. CONFIDENTIALITY

7.1 **Confidential Information**. "**Confidential Information**" means all non-public Know-How or other information, including proprietary materials or information, transferred, disclosed or otherwise made available by or on behalf of a Party (the "**Disclosing Party**") to the other Party or its permitted recipients (the "**Receiving Party**") prior to, on or after the Effective Date, whether or not patentable and whether or not disclosed in written, oral graphical, machine-readable, electronic or other form or otherwise observed by the Receiving Party,

and whether or not such information is marked as confidential or proprietary. It is understood and agreed by the Parties that:

7.1.1 The terms and conditions of this Agreement will be considered Confidential Information of both Parties and kept confidential by each of the Parties as set forth in this Article 9.

7.1.2 The GalXC Foreground IP and the Licensed Intellectual Property shall be considered the Confidential Information of DICERNA, with DICERNA deemed to be the Disclosing Party and ALEXION deemed to be the Receiving Party with respect thereto.

7.1.3 The identities of the Additional Complement Pathway Targets and the Targets, the Candidate Products, the Products, all Product IP and all Results (including Product IP and Results for any Product that contains or incorporates such Candidate Product) shall be considered the Confidential Information of ALEXION, with ALEXION deemed to be the Disclosing Party and DICERNA deemed to be the Receiving Party with respect thereto.

7.2 **Non-Disclosure and Non-Use Obligation**. Except as otherwise expressly set forth herein, the Receiving Party shall keep the Confidential Information of the Disclosing Party confidential using at least the same degree of care with which the Receiving Party holds its own confidential information and shall not (i) disclose such Confidential Information to any person or entity without the prior written approval of the Disclosing Party, except, solely to the extent necessary to exercise its rights or perform its obligations under this Agreement, to its employees, Affiliates, Sublicensees and contractors, consultants or agents who have a need to know such Confidential Information, all of whom will be similarly bound by the provisions of this Article 9 and for whom the Disclosing Party will be responsible, or (ii) use such Confidential Information for any purpose other than for the purposes contemplated by this Agreement. The Receiving Party will use diligent efforts to cause the foregoing entities and persons to comply with the restrictions on use and disclosure set forth in this Section 9.2, and shall be responsible for ensuring that such entities and persons maintain the Disclosing Party's Confidential Information in accordance with this Article 9.

7.3 **Return of Confidential Information**. Upon the expiration or termination of this Agreement, the Receiving Party shall return (or, as directed by the Disclosing Party, destroy) all Confidential Information of the Disclosing Party to the Disclosing Party that is in the Receiving Party's possession or control, provided, however, one (1) copy may be retained and stored solely for the purpose of determining its obligations under this Agreement, provided that the non-disclosure and non-use obligation under this Article 9 shall continue to apply to any such copies. In addition, the Receiving Party shall not be required to return or destroy Confidential Information contained in any computer system back-up records made in the ordinary course of business; provided, that such Confidential Information may not be accessed without the Disclosing Party's prior written consent or as required by Applicable Law.

7.4 **Exemption**. The foregoing confidentiality and non-use obligations shall not apply, to the extent that the Receiving Party can so demonstrate, to: (i) information already in the possession of the Receiving Party prior to its disclosure by the Disclosing Party as evidenced by written records, (ii) information which comes into the public domain by publication or otherwise through no breach of the obligations of confidentiality and non-use hereunder by the Receiving Party, including with respect to Section 11.1, (iii) information which has been disclosed to the Receiving Party from another source free from any obligation of confidentiality and which was not directly or indirectly obtained from the Disclosing Party, or (iv) information which is developed independently by employees, subcontractors, consultants or agents of the Receiving Party or any of its Affiliates without use of or reliance upon the Disclosing Party's Confidential Information, as evidenced by contemporaneous written records.

7.5 **Permitted Disclosures**. In addition to the exceptions contained in Sections 9.2 and 9.4, the Receiving Party may disclose Confidential Information of the Disclosing Party to the extent (and solely to the extent) that such disclosure is reasonably necessary in the following instances:

7.5.1 to comply with Applicable Law (including any securities law or regulation or the rules of a securities exchange pursuant to Section 9.6 below) or the order of a court of competent jurisdiction, provided that, where legally permissible, the Receiving Party promptly notifies the Disclosing Party of such obligation sufficiently prior to making such disclosure, so as to allow the Disclosing Party adequate time to take whatever action it may deem appropriate to protect the confidentiality of the information to be disclosed, and the information to be disclosed and fully cooperates with the Disclosing Party, if so requested, in maintaining the confidentiality of such information by applying for a protective order or any similar legal instrument. In any event, the compelled Receiving Party shall only disclose such Confidential Information to the extent required under Applicable Law and shall continue to treat such information as Confidential Information for all other purposes under this Agreement;

7.5.2 to prosecute or defend litigation or to otherwise exercise its rights or perform its obligations in Section 10.4.2 above, Regulatory Approvals and other regulatory filings and communications, to file or prosecute patent applications or regulatory filings as contemplated by this Agreement so long as there is [***] days' prior written notice before filing and to enforce Patent Rights in connection with the Receiving Party's rights and obligations pursuant to this Agreement; and

7.5.3 to allow the Receiving Party to exercise its rights and perform its obligations hereunder, provided that such disclosure is covered by terms of confidentiality and non-use at least as restrictive as those set forth herein.

7.6 **Disclosure of Agreement**. Either Party 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 *bona fide* prospective or actual acquirers, permitted assignees or merger candidates or to *bona fide* existing or potential investment bankers, investors and lenders, or financing sources, in a redacted form of this Agreement or its terms which shall be redacted in respect of (i) the identity of Targets, (ii) Development Milestone Events or Sales Milestone Events and Development Milestone Payments or Sales Milestone Payments under Section 7.3 (other than total potential milestones per Target), and (iii) royalties and computations in Section 7.4; provided that, either Party may disclose an unredacted form of this Agreement (including the foregoing information regarding Targets and payments) to *bona fide* potential or actual acquirers and permitted assignees or merger candidates, but only at such time as (x) the Disclosing Party 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 [***] Business Days and (y) such Third Party has executed with such Party, and such Party has provided to the other Party, a copy of a confidentiality agreement (redacted for name of party, economic terms or other competitive information) with terms substantially as protective with respect to Confidential Information as those contained herein, in a form reasonably acceptable to the other Party (which acceptance shall not be unreasonably withheld, conditioned or delayed); and provided further, that in the case of disclosure by DICERNA to a Competitor, DICERNA may only disclose such unredacted Agreement or its terms in a secure data room accessible only on a need to know basis with watermarking and controlled access with respect to the proposed transaction with such Competitor, and in accordance with the foregoing (x) and (y); and (c) 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 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 Article 9.

7.7 **Use of Name and Logo**. Subject to Section 11.2, neither DICERNA nor ALEXION shall use the other Party's or its Affiliates' name or logo in any label, press release or product advertising, or for any other promotional purpose, without first obtaining the other Party's written consent.

7.8 **Engaging Individuals**. Each Party hereby agrees that all individuals (including Sublicensees and subcontractors) engaged to perform any activities under this Agreement (including students, research assistants, etc.) shall be contractually bound by confidentiality obligations at least as restrictive as the obligations of confidentiality and non-use set forth in this Article 9 prior to performing such activities.

7.9 **Survival**. This Article 9 shall survive the expiry or termination of this Agreement and shall remain in full force and effect for [***] years after the expiry or termination of this Agreement.

8. INTELLECTUAL PROPERTY

8.1 **Ownership**.

8.1.1 **Background IP**. With the exception of Results and Product IP assigned to ALEXION under Section 10.1.3, each Party shall be and shall remain the owner of any Intellectual Property that (i) it developed or owned prior to the Effective Date of this Agreement or (ii) it independently develops or acquires during the Term outside the scope of the Target Validation Activities, Research Activities or Development Activities.

8.1.2 **GalXC Foreground IP**. ALEXION hereby agrees and acknowledges that, notwithstanding anything to the contrary in this Agreement, any and all GalXC Foreground IP shall be exclusively owned by DICERNA. ALEXION shall transfer and assign and hereby transfers and assigns, and agrees to transfer and assign, to DICERNA its entire right, title and interest to the GalXC Foreground IP, and all rights of actions and claims for damages and benefits arising due to past and present infringement of said GalXC Foreground IP and DICERNA hereby accepts the assignment provided for above in this Section 10.1.2.

8.1.3 **Results and Product IP**. With respect to any Product IP existing as of the Effective Date, DICERNA hereby transfers and assigns, and agrees to transfer and assign, to ALEXION, DICERNA's entire right, title and interest in and to such Product IP, and all rights of action and claims for damages and benefits arising due to past and present infringement of said Product IP. With respect to any Results or Product IP created during the Term, DICERNA hereby transfers and assigns, and agrees to transfer and assign, effective upon the creation of such Product IP and Results, to ALEXION, DICERNA's entire right, title and interest in and to all such Results and Product IP, including for all Candidate Products and Products, and all rights of action and claims for damages and benefits arising due to past and present infringement of said Product IP. ALEXION hereby accepts the assignments provided for above in this Section 10.1.3.

8.1.4 **Other New Inventions**. Except as expressly set forth in Section 10.1.2 or Section 10.1.3, as between the Parties [***].

8.1.5 **Disclosure of Inventions by Personnel**. Where any personnel of a Party (including any employee, agent or consultant hired by a Party, and any person or entity performing work on behalf of a Party or such Party's Affiliates) is involved in the Target Validation Activities, Research Activities or Development Activities or with access to the other Party's Know-How representing such other Party's Confidential Information, such Party shall ensure that such personnel informs such Party about any New Invention and such Party shall promptly inform the other Party of the same. The receiving Party shall treat any information on such New Invention(s) as Confidential Information in accordance with Article 9 of this Agreement.

8.1.6 **Execution and Assignment**. Each Party further agrees that it shall, [***].

8.1.7 **Inventorship**. Inventorship of patentable inventions conceived or reduced to practice during the course of performance of activities pursuant to this Agreement shall be determined in accordance with U.S. patent laws.

8.2 **Licenses**.

8.2.1 **Research License**. Subject to the terms and conditions of this Agreement, ALEXION hereby grants to DICERNA, during the Research Program Term and Initial Development Period, a royalty-free, non-exclusive, worldwide license to use the ALEXION Background Intellectual Property, Product IP and Results solely for the purpose of conducting any Target Validation Activities, Research Activities or Development Activities expressly allocated to DICERNA under this Agreement.

8.2.2 **Evaluation License**. Subject to the terms and conditions of this Agreement, DICERNA hereby grants to ALEXION and its Affiliates, during the Research Program Term, a worldwide, royalty-free, exclusive (even as to DICERNA) license, with the right to sublicense (subject to the provisions of Section 10.2.5 below), under the Licensed Intellectual Property solely for the purpose of carrying out (i) Research Activities or Development Activities expressly allocated to ALEXION pursuant to the Research Programs or pursuant to any Additional Research Work Plan(s) and (ii) the evaluation by ALEXION of the Candidate Products.

8.2.3 **Manufacturing License**. Subject to the terms and conditions of this Agreement, ALEXION hereby grants to DICERNA and its Affiliates, a worldwide, royalty-free, non-exclusive license, without the right to sublicense (except to CMOs of DICERNA as permitted under this Agreement or the Supply Agreement), under the ALEXION Background Intellectual Property, Product IP and Results, solely for the purpose of carrying out Manufacturing activities expressly allocated to DICERNA pursuant to this Agreement or the Supply Agreement.

8.2.4 **Development and Commercialization License**. Subject to the terms and conditions of this Agreement, DICERNA hereby grants to ALEXION and its Affiliates a worldwide, royalty-bearing in accordance with Article 7 of this Agreement, exclusive (even as to DICERNA, except to the extent necessary for DICERNA to conduct any Target Validation Activities, Research Activities, Development Activities or Manufacturing activities expressly allocated to DICERNA under this Agreement or the Supply Agreement) license, with the right to sublicense through multiple tiers (subject to the provisions of Section 10.2.5 below), under the Licensed Intellectual Property to Develop, have Developed, Manufacture, have Manufactured, use, have used, offer for sale, have offered for sale, sell, have sold, export, have exported, import, have imported, Commercialize and have Commercialized Products, or otherwise fully exploit Products in the Field in the Territory.

8.2.5 **Sublicensing**. [***].

8.2.6 **No Implied Licenses**. Except as expressly provided in this Agreement, neither Party shall be deemed to have granted the other Party any license or other right, title or interest, whether by implication, estoppel, reliance, or otherwise, with respect to any Intellectual Property of such Party.

8.3 **Patent Prosecution and Maintenance**.

8.3.1 **GalXC Foreground IP and Licensed Patent Rights**. [***].

8.3.2 **Product Patent Rights and Joint Patent Rights**. [***].

8.3.3 **Comment Rights**. [***].

8.3.4 **Prosecution Cooperation**. Each Party will cooperate with and reasonably assist the other Party in such preparation, filing, prosecution, issuance and maintenance, including making its relevant scientists and scientific records reasonably available. In addition, each Party will sign and deliver, or use reasonable efforts to have signed and delivered, at no charge to the requesting Party, all documents reasonably necessary for such preparation, filing, prosecution, issuance and maintenance of any Intellectual Property assigned to such requesting Party under this Agreement.

8.4 **Patent Enforcement**.

8.4.1 **Third Party Infringement**. During the Term, the Parties shall promptly inform each other in writing if either Party becomes aware of any suspected, threatened or actual infringement by any Third Party of a Product Patent Right or Licensed Patent Right ("**Infringed Patent**") and shall provide any available evidence of such suspected, threatened or actual infringement with such notification.

8.4.2 **Infringement Actions**.

(a) **Enforcement by DICERNA**. During the Term, where the Infringed Patent is a Licensed Patent Right, DICERNA shall have the sole right, but not the obligation, to enforce or defend the Infringed Patent against such Third Party, at DICERNA's cost and expense.

(a) **Enforcement by ALEXION**. During the Term, where the Infringed Patent is a Product Patent Right, ALEXION shall have the sole right, but not the obligation, to enforce or defend the Infringed Patent against such Third Party, at ALEXION's risk, cost and expense.

(b)**Cooperation**. Where the Party leading the enforcement or defense under this Section 10.4.2 (the "**Enforcing Party**") desires to enforce or defend such Infringed Patent but may not – even as the assignee or exclusive licensee of such Infringed Patent – do so due to Applicable Law or regulation, then the Enforcing Party may request that the other Party join as a named party in

such action or itself enforce or defend such Infringed Patent against such Third Parties, at the Enforcing Party's sole risk, cost and expense. The Enforcing Party shall take the lead in the control and conduct of any such enforcement or defense under this Section 10.4.2, in close coordination with the other Party, and the other Party shall reasonably assist the Enforcing Party at the Enforcing Party's expense, in any such enforcement or defense action under this Section 10.4.2.

8.4.3 **Third Party Patent Challenges**. In the case of any objection, opposition or challenge by a Third Party to a Licensed Patent Right, DICERNA shall have the sole right, but not the obligation, to defend such Licensed Patent Right against such Third Party, at DICERNA's cost and expense, and the provisions of Section 10.4.2(a) shall apply as if such opposed, challenged or objected to Licensed Patent Right were an Infringed Patent thereunder. In the case of any objection, opposition or challenge, by a Third Party, to a Product Patent Right, ALEXION shall have the sole right, but not the obligation, to defend such Product Patent Right against such Third Party, at ALEXION's cost and expense, and the provisions of Section 10.4.2(b) shall apply as if such opposed, challenged or objected to Product Patent Right were an Infringed Patent thereunder. Objections, oppositions and challenges to a Patent Right under this Section include, for example, declaratory judgment proceedings, *inter partes review* proceedings, post grant review proceedings, patent interference proceedings, ex parte and inter partes reexamination proceedings, and patent opposition proceedings in a court, patent office or other administrative authority with competent jurisdiction in any country within the Territory.

8.4.4 **Patent Listing**. ALEXION shall have the full and exclusive right, in its sole discretion, to determine and control the listing of any Patent Right (including any Product Patent Right or Joint Patent Right or, subject to this Section 10.4.4, any Licensed Patent Right) in the then-current edition of the United States Food and Drug Administration publication "Approved Drug Products with Therapeutic Equivalence Evaluations" (the "**Orange Book**"), or in equivalent patent listings in any other country within the Territory, in connection with the Regulatory Approval of any Product. If ALEXION desires to include in any such listing any Licensed Patent Right, then ALEXION shall notify DICERNA and shall consider in good faith DICERNA's reasonable comments with respect thereto, provided that ALEXION shall have the final decision with respect to any such listing.

8.4.5 **Enforcement of Listed Patents**. The provisions of Sections 10.4.2 and 10.4.3 notwithstanding, the following shall apply with respect to any notification provided by a Third Party to either ALEXION or DICERNA under 21 U.S.C. § 355(j)(2)(B) making a certification described in 21 U.S.C. §355(j)(2)(A)(vii)(IV) with respect to any Patent Right that is listed in the Orange Book for a Product and with respect to equivalent actions in the United States or in any other country within the Territory (a "**Paragraph IV Certification**"):

(a) The Party receiving a Paragraph IV Certification shall, without any avoidable delay and in any case within five (5) Business Days after receiving such a Paragraph IV Certification, notify the other Party in writing and shall attach a copy of the Paragraph IV Certification to such notification.

(b) The rights to initiate or continue any infringement proceeding as a result of the Paragraph IV Certification with respect to a Product, including the commencement of a patent infringement action under 35 U.S.C. § 271(e)(2)(A), or under an equivalent statute or regulation within any other country in the Territory (a "**Paragraph IV Proceeding**") shall be governed by Section 10.4.2, and any Patent Right subject to a Paragraph IV Proceeding shall be considered an Infringed Patent for purposes of interpreting Section 10.4.2.

8.4.6 **Recoveries**. Any amount recovered in any action under Section 10.4.2, 10.4.3 or 10.4.5, including any amount recovered in any settlement of such action, shall [***].

8.5 **Defense of Claims**. Each Party shall promptly inform the other in writing of any written notice to it of alleged infringement or misappropriation, based upon its performance of its obligations or exercise of its rights hereunder, of a Third Party's Intellectual Property of which it shall become aware. Except as otherwise set forth herein (including under Article 12), each Party shall have the sole right to defend against any such claim brought against it, provided, however, that to the extent such action resulting from such claim involves an objection, opposition or challenge to a Licensed Patent Right or Product Patent Right by such Third Party or a counterclaim involving an Infringed Patent, Section 10.4.2 or Section 10.4.3 shall apply, as applicable. Each Party shall each keep the other advised of all material developments in the conduct of any proceedings in defending any claim of such alleged infringement or misappropriation and shall reasonably cooperate with the other in the conduct of such defense. In no event may either Party settle any such infringement or misappropriation claim in a manner that would limit the rights of the other Party, admit the fault of the other Party or impose any obligation on the other Party, without such other Party's prior written consent, which consent shall not be unreasonably withheld, delayed or conditioned.

8.6 **Patent Term Extensions**. ALEXION shall have the full and exclusive right and discretion to determine and control all filings of requests for patent term extensions, supplementary protection certificates or equivalents thereto, in any country in the Territory, for any of the Product Patent Rights (hereinafter "**Patent Term Extensions**"). All costs and expenses relating to the Patent Term Extensions shall be born solely by ALEXION. Upon request of ALEXION and at ALEXION's costs, DICERNA shall provide support, assistance and all necessary documents, in full executed form if needed, to ALEXION for the purpose of supporting, filing, obtaining and maintaining Patent Term Extensions.

9. PUBLICATIONS

9.1 **Publication Rights**. ALEXION shall be the exclusive owner of any publication rights with respect to the Results, the Products and any Product IP, and shall have the sole and exclusive

right to publish on such Results, Products and Product IP without the prior consent of DICERNA, provided that any such abstract, publication or presentation of technology describing the Licensed Intellectual Property or DICERNA GalXC Technology, or any portion thereof, shall be subject to the prior review of DICERNA and shall be provided by ALEXION at least [***] Business Days prior to its submission for publication or presentation. DICERNA will use diligent efforts to complete its review at least [***] Business Days prior to ALEXION's intended publication or presentation date. ALEXION shall, as reasonably requested by DICERNA, (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 ten (10) Business Days in order to allow the appropriate Party to pursue patent protection.

9.2 **Press Release**. The Parties may issue a press release following the execution of this Agreement describing the nature of the collaboration between ALEXION and DICERNA in the form as mutually agreed to by the Parties.

10. INDEMNIFICATION AND LIABILITY

10.1 **Indemnification by DICERNA**. DICERNA shall indemnify, defend, and hold harmless ALEXION and its Affiliates and their respective officers, directors, employees, licensees, and agents, and their respective successors, heirs and assigns and representatives (the "**ALEXION Indemnitees**"), from and against any and all damages, losses, suits, proceedings, liabilities, costs and expenses (including reasonable legal expenses, costs of litigation and reasonable attorney's fees) or judgments, whether for money or equitable relief, of any kind (collectively, "**Damages**") resulting from any and all suits, investigations, claims or demands of Third Parties (collectively, "**Third Party Claims** ") brought against an ALEXION Indemnitee, to the extent directly or indirectly arising out of or relating to: (i) the gross negligence or willful misconduct of DICERNA, its Affiliates and its and their subcontractors and its respective officers, directors, or employees in connection with DICERNA's performance of its obligations under this Agreement, (ii) any breach by DICERNA of any obligation, representation, warranty or covenant set forth in this Agreement, (iii) Third Party allegations that the practice of the DICERNA GalXC Technology infringes or misappropriates any Intellectual Property of a Third Party, or (iv) the failure of DICERNA or its Affiliates or any of its subcontractors to comply with any Applicable Laws, in each case except to the extent ALEXION is liable for such Damages pursuant to Section 12.2.

10.2 **Indemnification by ALEXION**. ALEXION shall indemnify, defend, and hold harmless DICERNA and its Affiliates, and its and their respective officers, directors, employees, and agents, and their respective successors, heirs and assigns and representatives (the "**DICERNA Indemnitees**"), from and against any and all Damages resulting from Third Party Claims against a DICERNA Indemnitee (including by ALEXION employees), to the extent directly or indirectly arising out of or relating to (i) the gross negligence or willful misconduct of ALEXION, its Affiliates, and its and their respective licensees, officers,

directors, employees in connection with ALEXION's performance of its obligations or exercise of its rights under this Agreement, (ii) any breach by ALEXION of any obligation, representation, warranty or covenant set forth in this Agreement, (iii) the failure to comply with any Applicable Laws by ALEXION, its Affiliates, or any of its licensees or subcontractors, or (iv) use, Manufacture, Commercialization or other exploitation of any Candidate Product or Product by or on behalf of ALEXION or its Affiliates or Sublicensees, in each case except to the extent DICERNA is liable for such Damages pursuant to Section 12.1.

10.3 **Notification; Assumption of Defense; Cooperation and Assistance**. In the event that a Party seeks indemnification hereunder with respect to a Third Party Claim, the Party seeking indemnification (the "**Indemnified Party**") shall promptly notify the other Party (the "**Indemnifying Party**") in writing (an "**Indemnification Claim Notice**") of any Third Party Claim in respect of which it intends to claim indemnification under this Section 12.3 upon actual knowledge of any such claim or proceeding resulting in Damages, but in no event will the Indemnifying Party be liable for any Damages that result from any delay in providing such notice. The Indemnification Claim Notice must contain a description of the claim and the nature and amount of such Damages (to the extent that the nature and amount of such Damages is known at such time). The Indemnifying Party may, at its option, assume exclusive control of the defense and settlement of the Third Party Claim, subject to the limitations on settlement set forth below and in Section 10.5. If the Indemnifying Party assumes such defense, then such assumption by the Indemnifying Party will not be construed as an acknowledgement that the Indemnifying Party is liable to indemnify the Indemnified Party of any defenses it may assert against the Indemnified Party's claim for indemnification and the Indemnifying Party may appoint as lead counsel in the defense of the Third Party Claim any legal counsel selected by the Indemnifying Party (the Indemnifying Party will consult with the Indemnified Party with respect to a possible conflict of interest of such counsel retained by the Indemnifying Party). The Indemnified Party will have the right to participate in the defense thereof and to employ counsel, at its own expense, separate from the counsel employed by the Indemnifying Party. If the Indemnifying Party does not commence actions to assume control of the defense of a Third Party Claim within [***] days after the receipt by the Indemnifying Party of the Indemnification Claim Notice required pursuant to this Section 12.3, the Indemnified Party will have the right to defend such claim in such manner as it may deem appropriate at the reasonable cost and expense of the Indemnifying Party. The Indemnified Party shall cooperate as may be reasonably requested by the Indemnifying Party (and at the Indemnifying Party's expense) in order to ensure the proper and adequate defense of any action, claim or liability covered by this indemnification. The Indemnifying Party may not settle or otherwise dispose of any Third Party Claim without the prior written consent of the Indemnified Party unless such settlement includes only the payment of monetary damages (which are fully paid by the Indemnifying Party), does not impose any injunctive or equitable relief upon the Indemnified Party, does not require any admission or acknowledgment of liability or fault of the Indemnified Party and contains an unconditional release of the Indemnified Party in respect of such Third Party Claim. Regardless of whether the Indemnifying Party chooses to defend or prosecute any Third Party Claim, no Indemnified Party will admit any liability with respect to or settle or

otherwise dispose of any Third Party Claim for which the Indemnifying Party may be liable for Damages under this Agreement without the prior written consent of the Indemnifying Party, such consent not to be unreasonably withheld.

1. TERM AND TERMINATION

1.1 **Term**. This Agreement shall commence upon the Effective Date and, if not otherwise terminated earlier pursuant to this Article 13, shall continue in full force and effect (a) on a Product-by-Product basis, until the expiration of the last payment obligation by ALEXION with respect to such Product and (b) on a Target-by-Target basis until (i) the Discontinuation Date for a given Target (as applicable), or (ii) if no Product has been nominated by ALEXION pursuant to Section 2.2.3 for a given Target, on the date the applicable Evaluation Period expires for the last Candidate Product for such Target (including any replacement Targets selected under Section 2.2.2(b)) (collectively, the "**Term**").

1.2 **Termination for Cause**.

1.2.1 **By ALEXION**. In the event of a material breach of this Agreement by DICERNA, which material breach remains uncured for [***] days measured from the date of written notice of such material breach by ALEXION, which notice identifies the material breach and the actions or conduct that it reasonably considers would be an acceptable cure of such material breach, ALEXION may terminate this Agreement in whole or with respect to one or more Candidate Products, Products or Targets, at any time during the Term of this Agreement by written notice of termination to DICERNA.

1.2.2 **By DICERNA**. In the event of a material breach of this Agreement by ALEXION, which material breach remains uncured for [***] days measured from the date written of written notice of such material breach by DICERNA, which notice identifies the material breach and the actions or conduct that it reasonably considers would be an acceptable cure of such material breach, DICERNA may terminate this Agreement solely with respect to one or more Candidate Products, Products or Targets to which such material breach relates, at any time during the Term of this Agreement by written notice of termination to ALEXION.

1.2.3 **Disputes regarding Material Breach**. In case the Party alleged to have committed the material breach (the "**Defaulting Party**") disputes the material breach identified under Section 13.2.1 or 13.2.2 by the other Party (the "**Non-Defaulting Party**"), then the issue of whether the Non-Defaulting Party may properly terminate this Agreement on expiration of the applicable cure period shall be resolved in accordance with Section 14.8. If as a result of such dispute resolution process, it is determined that the Defaulting Party committed a material breach and the Defaulting Party does not cure such material breach within [***] days after the date of such determination, (the "**Additional Cure Period**"), then such termination shall be effective as of the expiration of the Additional Cure Period. If the Parties dispute whether such material breach was so cured, such dispute shall also be determined in accordance with Section

14.8. This Agreement shall remain in full force and effect while any such dispute resolution proceeding is pending, such proceeding shall not suspend any obligations of either Party hereunder, and each Party shall use reasonable efforts to mitigate any damage. If as a result of such dispute resolution proceeding it is determined that the Defaulting Party did not commit such material breach (or such material breach was cured in accordance with this Section 13.2), then no termination shall be effective, and this Agreement shall continue in full force and effect.

1.3 **Termination for Insolvency**. To the extent permitted by Applicable Laws, either Party may terminate this Agreement upon the filing or institution of bankruptcy, reorganization, liquidation or receivership proceedings, upon the appointment of a receiver or trustee over all or substantially all property, or upon an assignment of a substantial portion of the assets for the benefit of creditors by the other Party; provided, however, that in the case of any involuntary bankruptcy proceeding such right to terminate shall only become effective if the Party consents to the involuntary bankruptcy or such proceeding is not dismissed within sixty (60) days after the filing thereof (an "**Insolvency Event**").

1.3.1 All rights and licenses now or hereafter granted by DICERNA to ALEXION under or pursuant to this Agreement are, for all purposes of Section 365(n) of the U.S. Bankruptcy Code, licenses of rights to "intellectual property" as defined in the U.S. Bankruptcy Code. Upon an Insolvency Event, DICERNA agrees that ALEXION, as licensee of such rights under this Agreement, will retain and may fully exercise all of its rights and elections under the U.S. Bankruptcy Code. DICERNA will, during the Term, create and maintain current copies or, if not amenable to copying, detailed descriptions or other appropriate embodiments, to the extent feasible, of all intellectual property licensed under this Agreement. Each Party acknowledges and agrees that "embodiments" of intellectual property within the meaning of Section 365(n) include laboratory notebooks, cell lines, product samples and inventory, research studies and data, all Regulatory Approvals (and all applications for Regulatory Approval) and rights of reference therein, the Licensed IP and Product IP and all information related to the Licensed IP and Product IP. If (i) a case under the U.S. Bankruptcy Code is commenced by or against DICERNA, (ii) this Agreement is rejected as provided in section 365 of the U.S. Bankruptcy Code and (iii) ALEXION elects to retain its rights hereunder as provided in Section 365(n) of the U.S. Bankruptcy Code, DICERNA (in any capacity, including debtor-in-possession) and its successors and assigns (including a trustee) will:

(a) provide ALEXION with embodiments of all Licensed IP and Product IP held by DICERNA and such successors and assigns, or otherwise available to them, immediately upon ALEXION's written request, and ALEXION will have the right to perform DICERNA's obligations hereunder and exercise all of the rights of a licensee of intellectual property under section 365(n) of the Bankruptcy Code, provided that neither such provision nor such performance by ALEXION will release DICERNA from liability resulting from rejection of the license or the failure to perform such obligations; and

(b) not interfere with ALEXION's rights under this Agreement, or any agreement supplemental hereto, to such intellectual property (including such embodiments), including any right to obtain such intellectual property (or such embodiments) from another entity, to the extent provided in Section 365(n) of the U.S. Bankruptcy Code.

1.3.2 All rights, powers and remedies of ALEXION provided herein are in addition to and not in substitution for any other rights, powers and remedies now or hereafter existing at law or in equity (including the U.S. Bankruptcy Code) in the event of the commencement of a case under the U.S. Bankruptcy Code with respect to DICERNA. The Parties intend the following rights to extend to the maximum extent permitted by Applicable Law, and to be enforceable under U.S. Bankruptcy Code Section 365(n):

(a) the right of access to any intellectual property rights (including all embodiments thereof) of DICERNA, or any Third Party with whom DICERNA contracts to perform an obligation of DICERNA under this Agreement to the extent that DICERNA is not performing such obligation, and, in the case of any such Third Party, which is necessary for the Manufacture, use, sale, offer for sale, import or export of Products; and

(b) the right to contract directly with any Third Party to complete the contracted work to the extent that DICERNA is not completing or having completed the contracted work.

1.4 **Termination at Will**. ALEXION shall be entitled to terminate this Agreement, in whole or with respect to one or more Candidate Products, Products or Targets, at its sole discretion at any time upon ninety (90) days' prior written notice to DICERNA thereof.

1.1 **Termination for DICERNA Change of Control**.

1.1.1 In the event of a Change of Control involving a Competitor, ALEXION may terminate this Agreement in whole or with respect to one or more Candidate Products, Products or Targets, within [***] days after receiving the Change of Control Notice, by sending written notice of such termination to DICERNA within such [***] day period, with such termination being effective immediately prior to the closing of such Change of Control transaction; provided, however, that [***].

1.1.2 Notwithstanding the foregoing, the right to terminate set forth above in Section 13.5.1 for a change of control shall not apply for so long as [***].

1.1 **Effects of Termination**.

1.1.1 **Generally**. Upon termination (but not expiration) of the Agreement in whole or with respect to one or more Candidate Products, Products, Targets or Discontinued Targets:

(a) The Receiving Party shall promptly return to the other Party or destroy all Confidential Information of the Disclosing Party that is solely related to any such terminated Candidate Product, Product, Target or Discontinued Target in accordance with Section 9.3 above;

(b) All licenses granted by DICERNA to ALEXION under this Agreement with respect to any such terminated Candidate Product, Product Target or Discontinued Target shall immediately terminate;

(c) The licenses granted by ALEXION to DICERNA pursuant to Section 10.2.1 and 10.2.3 shall terminate; and

(d) Each Party shall be relieved of the exclusivity obligations under Section 2.8 of this Agreement with respect to any such terminated Targets or Discontinued Targets.

1.1.2 **Knowledge Transfer**. To the extent not provided by the effective date of termination of this Agreement or the Discontinuation Date (as applicable), DICERNA shall promptly provide to ALEXION, on a Candidate Product-by-Candidate Product or Product-by-Product basis, copies of all data, Results, Deliverables, Product IP and any other information provided by Section 5.1 or Section 6.4, and ALEXION shall promptly provide to DICERNA, on a Candidate Product-by-Candidate Product or Product-by-Product basis, copies of all GalXC Foreground IP, the costs of which provision shall be borne by (i) DICERNA in the event of a termination by ALEXION pursuant to Section 13.2.1 or 13.3, and (ii) ALEXION in the event of a termination by DICERNA pursuant to Section 13.2.2 or 13.3 or a termination by ALEXION pursuant to Section 13.4.

1.1.3 **Grant-Back License and Option**.

(a) Upon the termination of this Agreement (i) with respect to a Candidate Product or Product by DICERNA pursuant to Section 13.2.2 or 13.3 or by ALEXION pursuant to Section 13.4 or (ii) with respect to a Candidate Product directed to a Discontinued Target under Section 2.2.3, ALEXION hereby grants and agrees to grant to DICERNA, effective as of the effective date of such termination, a [***].

(b) Upon DICERNA's written request to ALEXION at any time during the period starting on the effective date of any such termination with respect to a Continuation Product and ending [***] days thereafter, the Parties shall negotiate in good faith for a period of [***] days the terms of a grant-back agreement (each, a "**Grant-Back Agreement**") pursuant to which ALEXION would grant to DICERNA [***]. If DICERNA does not provide such a written request to ALEXION within such [***] day period following the termination of this Agreement with respect to a given Continuation Product or if, following such request and good faith negotiation, the Parties

fail to reach agreement on the terms of a Grant-Back Agreement with respect to such Continuation Product within such [***]-day period, then ALEXION shall have no further obligation to negotiate with DICERNA the terms of any Grant-Back Agreement with respect to such Continuation Product. Notwithstanding any provision of this Agreement to the contrary, neither Party will be obligated to enter into any Grant-Back Agreement and neither Party will have any liability to the other Party for any failure to do so.

1.1 **Alternative Remedy in Lieu of Termination**. If ALEXION has the right to terminate this Agreement pursuant to Section 13.2, 13.3 or 13.5 above, in addition to any other remedies available to ALEXION at law or in equity, ALEXION may, in its sole discretion, in lieu of terminating this Agreement, exercise an alternative remedy as follows:

(i) ALEXION may retain all of its licenses and other rights granted under this Agreement, subject to all of its payment and other obligations; except that the applicable [***] payable thereafter under this Agreement shall be reduced by [***] percent [***] (and thereafter, [***] shall be reduced to [***] percent [***] of Net Sales); and

(ii) any ALEXION Confidential Information provided to DICERNA pursuant to this Agreement will be promptly returned to ALEXION or destroyed, and ALEXION shall be released from its ongoing disclosure and information exchange obligations with respect to activities following the date of such election.

For the avoidance of doubt, except as set forth in this Section 13.7, in the event ALEXION exercises the alternative remedy set forth above in this Section 13.7, all rights and obligations of both Parties under this Agreement shall continue unaffected, unless this Agreement is subsequently terminated by either Party pursuant to this Article 13.

1.2 **Rights Accruing Prior to Expiration or Termination**. Expiration or termination of this Agreement shall not relieve the Parties of any obligation accruing prior to such expiration or termination. Any expiration or termination of this Agreement shall be without prejudice to the rights of either Party against the other accrued or accruing under this Agreement prior to expiration or termination, including any payment obligation that accrued prior to the effective date of such expiration or termination.

1.3 **Survival**. In addition to any provisions specified in this Agreement as surviving as set forth therein, the provisions of Articles 1, 7 (solely with respect to payment obligations accruing prior to the effective date of termination), 9 (for the applicable time period set forth therein) and 12 (solely with respect to Third Party Claims arising out of circumstances occurring prior to the effective date of termination), Sections 5.6, 8.4, 8.5, 10.1, 10.2.6, 10.3.4, 10.4.2(c), 13.6, 13.8, this Section 13.9 and Sections 14.2 through 14.13 shall survive any termination or expiration of the Agreement. In addition, all rights and obligations contained in this Agreement, which by their nature or effect contemplate performance or observance

subsequent to expiration or termination of this Agreement will survive and remain binding upon and for the benefit of the Parties, their successors and permitted assigns.

2. CONCLUDING PROVISIONS

2.1 **Assignment and Change of Control**. Neither Party shall be entitled to assign or otherwise transfer its rights and/or obligations under this Agreement in whole or in part to any Third Party without the prior written consent of the other Party, which consent shall not be unreasonably withheld; provided that, notwithstanding the foregoing, each Party may assign this Agreement to (i) any Affiliate, or (ii) any successor corporation or entity resulting from any Change of Control of such Party; and provided further, that any such successor Affiliate, entity or Third Party to which this Agreement is assigned expressly agrees in writing to assume and be bound by all obligations of the assigning Party under this Agreement. Any Third Party involved in a Change of Control as set forth in the foregoing subclause (ii) of this Section 14.1 and such Third Party's Affiliates immediately prior to such Change of Control shall be referred to herein as the "**Acquirer**". Notwithstanding the foregoing, in the event that a Change of Control with respect to DICERNA pursuant to the foregoing (ii) involves a Competitor, then DICERNA shall promptly notify ALEXION of such contemplated Change of Control, but in any event within [***] Business Days prior to the anticipated signing of a definitive agreement with respect to such contemplated Change of Control, and ALEXION shall have the right to terminate this Agreement in accordance with Section 13.2.1.

2.2 **Entire Agreement; Amendments**. This Agreement sets forth the entire agreement between the Parties and supersedes all previous and contemporaneous negotiations, representations or agreements, written or oral, regarding the subject matter hereof. This Agreement may be amended only by an instrument in writing duly executed on behalf of the Parties. 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.

2.3 **Force Majeure**. Neither Party shall be liable or deemed in default for failure to perform any duty or obligation that such Party may have under this Agreement where such failure has been occasioned by any act of God, fire, external strike, inevitable accidents, war, or any other cause outside the reasonable control of that Party, and occurring without its fault or negligence; provided that the Party affected will promptly notify the other of the force majeure condition and will exert all reasonable efforts to eliminate, cure or overcome any such causes and to resume performance of its obligations as soon as possible.

2.4 **Waiver**. The failure of either Party to require performance by the other Party of any of that other Party's obligations under this Agreement shall in no manner affect the right of such Party to enforce the same at a later time. No waiver by any Party of any condition, or of the breach of any provision, term, representation or warranty contained in this Agreement shall be deemed to be or construed as a further or continuing waiver of any such condition or breach, or of any other condition or of the breach of any other provision, term, representation, or warranty hereof. The remedies provided in this Agreement are not

exclusive and the Party suffering from a breach or default of this Agreement may pursue all other remedies, both legal and equitable, alternatively or cumulatively.

2.5 **Severability**. In the event that any provision or portion thereof in this Agreement is for any reason held to be invalid, illegal or unenforceable, the same shall not affect any other portion of this Agreement and its validity, as it is the intent of the Parties that this Agreement shall be construed in such fashion as to maintain its existence, validity and enforceability to the greatest extent possible. In any such event, this Agreement shall be construed as if such provision or portion thereof had never been contained in this Agreement, and there shall be deemed substituted therefore such provision as will most nearly carry out the intent of the Parties as expressed in this Agreement to the fullest extent permitted by Applicable Law unless doing so would have the effect of materially altering the right and obligations of the Parties in which event this Agreement may be terminated by mutual written agreement of the Parties.

2.6 **Notices**. Any notices and Invoices given under this Agreement shall be in writing and shall be addressed as follows (or at such other address for a Party as shall be specified by like notice, provided, however, that notices of a change of address shall be effective only upon receipt thereof):

1 If to DICERNA:

2 Dicerna Pharmaceuticals, Inc.
87 Cambridgepark Drive
Cambridge, MA 02140
Attention: President and Chief Executive Officer
Facsimile: (617) 612-6298
[***]

3 With a copy to:

4 Dicerna Pharmaceuticals, Inc.
87 Cambridgepark Drive
Cambridge, MA 02140
Attention: Legal Department

5 If to ALEXION:

Alexion Pharma Holding Unlimited Company
[***]
6 Attn: Secretary

7 With a copy to:

8 Alexion Pharmaceuticals, Inc.

121 Seaport Blvd

Boston, MA 02210

Attn: General Counsel

2.7 **Governing Law**. This Agreement shall be construed in accordance with and governed exclusively by the law of The Commonwealth of Massachusetts, without reference to its rules of conflict of law.

2.8 **Dispute Resolution.** Any dispute arising out of or in connection with this Agreement shall be settled, if possible, through good faith negotiations between the Parties. If the Parties are unable to settle such dispute within [***] days of first considering such dispute, [***]. Such resolution, if any, of a referred issue shall be final and binding on the Parties. All negotiations pursuant to this Section 14.8 are confidential and shall be treated as compromise and settlement negotiations for purposes of applicable rules of evidence. [***].

2.9 **Relationship of the Parties**. Nothing in this Agreement is intended or will be deemed to constitute a partnership, agency, employer-employee or joint venture relationship between the Parties. No Party will incur any debts or make any commitments for the other. There are no express or implied third party beneficiaries hereunder (except for ALEXION Indemnitees and DICERNA Indemnitees for purposes of Sections 12.1 or 12.2).

2.10 **Headings**. The captions to the Articles and Sections of this Agreement are not a part of this Agreement, but are merely for convenience to assist in locating and reading the several Sections of this Agreement.

2.11 **Counterparts; Facsimiles.** 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. Facsimile or PDF execution and delivery of this Agreement by either Party will constitute a legal, valid and binding execution and delivery of this Agreement by such Party.

2.12 **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) the word “will” shall be construed to have the same meaning and effect as the word “shall”, (d) 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), (e) any reference herein to any person or entity shall be construed to include the person's or entity's successors and assigns, (f) 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, (g) all references herein to Sections, Exhibits or Schedules shall be construed to refer to Sections, Exhibits or Schedules of this Agreement, and references to this Agreement include all Exhibits, Schedules and Appendixes hereto, (h) the word "notice" means notice in writing (whether or not specifically stated) and shall include notices, consents, approvals and other written communications contemplated under this Agreement, (i) provisions that require that a Party, the Parties or any 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 (but excluding e-mail and instant messaging), (j) 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, (k) the term "or" shall be interpreted in the inclusive sense commonly associated with the term "and/or", and (l) references to any Sections include Sections and subsections that are part of the related Section (*e.g.*, a section numbered "Section 2.2" would be part of "Section 2", and references to "Section 2.2" would also refer to material contained in the subsection described as "Section 2.2(a)").

2.13 **Further Assurances**. Subject to the terms and conditions of this Agreement, each of DICERNA and ALEXION agrees to duly execute and deliver, or cause to be duly executed or delivered, such further instruments and do and cause to be done such further acts, including the filing of additional assignments, agreements, documents and instruments, as the other Party may at any time and from time to time reasonably request in connection with this Agreement or to carry out more effectively the provisions and purposes of, or to better assure and confirm unto such other Party its rights and remedies under, this Agreement.

[*Signature Page Follows*]**IN WITNESS WHEREOF**, the Parties have executed this Agreement in duplicate originals by their duly authorized representatives as of the date and year first above written

Alexion Pharma Holding Unlimited Company

By: /s/ Kirk Caza

Name: Kirk Caza

Title: Director

Dicerna Pharmaceuticals Inc.

By: /s/ Douglas M. Fambrough

Name: Douglas M. Fambrough

Title: President & CEO

Dicerna Cayman

By: /s/ Douglas M. Fambrough

Name: Douglas M. Fambrough

Title: Chairman

Appendices:

APPENDIX 1(a): Initial Research Work Plan
APPENDIX 1(b): Research Program Milestone Events and Payments
APPENDIX 2: Additional Complement Pathway Targets
APPENDIX 3: Development Plan(s)
APPENDIX 4: Contact List
APPENDIX 5: Licensed Patent Rights
APPENDIX 6: Example Royalty Calculation

Schedules:
Schedule 2.5.3: Approved Subcontractors
Schedule 6.2.1: Supply Agreement Key Terms

APPENDIX 1(a)

Initial Research Work Plan

Part 1: Overview

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Part 2: Year 1 detailed (Q4 2018 - Q3 2019)

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APPENDIX 1(b)

Research Program Milestone Events and Payments

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APPENDIX 2

Additional Complement Pathway Targets

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APPENDIX 3

Development Plan(s)

[*TO BE ATTACHED IF APPLICABLE IN ACCORDANCE WITH SECTION 3.1.1.*]APPENDIX 4

Contact List

[***]	**[***]**	**[***]**	**[***]**
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APPENDIX 5

Licensed Patent Rights

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APPENDIX 6

Example Royalty Calculation

[***]**SCHEDULE 2.5.3**

Approved Subcontractors

[*To be provided within [***] after the Effective Date***]SCHEDULE 6.2.1**

Supply Agreement Key Terms

[***]

SHARE ISSUANCE AGREEMENT

THIS SHARE ISSUANCE AGREEMENT (this "**Agreement**"), is made as of October 22, 2018, by and between Alexion Pharmaceuticals, Inc., a Delaware corporation (the "**Share Acquiror**"), and Dicerna Pharmaceuticals, Inc., a Delaware corporation (the "**Company**").

WHEREAS, concurrently with the entering into of this Agreement, the Company and Alexion Pharma Holding Unlimited Company, an Affiliate of the Share Acquiror, are entering into that certain Collaborative Research and License Agreement (the "**Collaborative Agreement**");

WHEREAS, pursuant to the terms and subject to the conditions set forth in this Agreement, the Company desires to issue to the Share Acquiror, and the Share Acquiror desires to acquire from the Company, at the Closing (as defined below), 835,834 shares (the "**Shares**") of the Company's common stock, par value $0.0001 per share ("**Common Stock**") for an aggregate purchase price of $15,003,220.30 (the "**Purchase Price**");

NOW, THEREFORE, in consideration of the foregoing recitals, the mutual representations, warranties, promises and obligations in the Collaborative 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:

"**Affiliate**" shall have the meaning set forth in Section 405 under the Securities Act.

"**Agreement**" means as set forth in the Preamble, including all exhibits attached hereto.

"**Business Day**" means a day on which commercial banking institutions in Boston, Massachusetts and New York, New York are open for business.

"**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.

"**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.

"**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.

"**Law**" or "**Laws**" means all laws, statutes, rules, regulations, orders, judgments, injunctions and/or ordinances of any Governmental Authority.

"**Organizational Documents**" means (i) the 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 (ii) 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 such transfer, 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.

"**Securities Act**" means the Securities Act of 1933, as amended.

"**Third Party**" means any Person other than the Share Acquiror, the Company or any Affiliate of the Share Acquiror or the Company.

"**Transaction**" 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.

"**Transaction Agreements**" means this Agreement and the Collaborative Agreement.

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
Share Acquiror	Preamble
Closing	Section 3.1
Closing Date	Section 3.1
Common Stock	Recitals
Company	Preamble
Enforceability Exceptions	Section 4.2(b)
Lockup Period	Section 6
Lockup Shares	Section 6
Purchase Price	Recitals
Registration Statement	Section 3.2
Required Approvals	Section 4.4
SEC	Section 4.4
Shares	Recitals

2. Issuance of Common Stock. Subject to the terms and conditions of this Agreement, at the Closing, the Company shall issue to the Share Acquiror and the Share Acquiror shall acquire from the Company the Shares.

3. Closing Date; Deliveries.

3.1 Closing Date. The closing of the acquisition and issuance of the Shares hereunder (the "**Closing**") shall be held on the date hereof by electronic exchange of signature pages and Shares or at such other time, date and location as the parties may mutually agree in writing. The date the Closing occurs is hereinafter referred to as the "**Closing Date**."

3.2 Deliveries. At the Closing, (a) the Company shall deliver or cause to be delivered to the Share Acquiror (i) the Shares in book-entry form and (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 and (b) 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 not less than three (3) Business Days prior to the Closing Date.

4. Representations and Warranties of the Company. The Company hereby represents and warrants to the Share Acquiror as of the date hereof 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 power and authority to enter into this Agreement, to issue the Shares and to perform its obligations under and to carry out the other transactions contemplated by this Agreement.

4.2 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 their respective 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**").

4.3 No Conflicts. The execution, delivery and performance of this Agreement, and compliance with the provisions hereof and thereof, 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, or (c) violate or conflict with any of the provisions of the Organizational Documents, except, in the case of subsections (a) and (b) as would not have or be reasonably likely to have a material adverse effect with respect to this Agreement.

4.4 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 in connection with the authorization, execution and delivery by the Company of this Agreement or with the authorization, issuance by the Company of the Shares, except (a) such filings as may be required to be made with the Securities and Exchange Commission (the "**SEC**"), which filings shall be made in a timely manner in accordance with all applicable Laws, and (b) those that have been made or obtained prior to the date of this Agreement (the items referred to in clauses (a) and (b), the "**Required Approvals**").

4.5 Valid Issuance of Shares. When issued and delivered at the Closing in accordance with the terms hereof in satisfaction of the Company's obligation to deliver the Shares pursuant to the Collaborative Agreement, 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 or other similar rights, other than as set forth in the Transaction Agreements, 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 filings referenced in Section 4.4, 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.

4.6 NASDAQ Listing. Common Stock is listed on The Nasdaq Global Select Market, 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 or (b) designed to delist or reasonably likely to cause the delisting of the Common Stock from The Nasdaq Global Select Market.

4.7 SEC Reports. Parent has filed all required forms, reports and documents with the SEC since January 1, 2018 ("**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.

4.8 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 contemplated by this Agreement.

4.9 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.

4.10 No General Solicitation. Neither the Company nor, to the Company's knowledge, any Person acting on behalf of the Company has either directly or indirectly, including through a broker or finder, engaged in any general solicitation or published any advertisement in connection with the offer and issuance of the Shares.

5. Representations and Warranties of the Share Acquiror. The Share Acquiror hereby represents and warrants to the Company as of the date hereof as follows:

5.1 Organization. The Share Acquiror is a corporation duly organized, validly existing and in good standing under the laws of Delaware. 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 other transactions contemplated by this Agreement.

5.2 Authorization. All requisite action on the part of the Share Acquiror and its directors and stockholders, 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 thereunder, 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 their respective 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 contemplated by, 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.

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, agreement 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.

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 of the Securities Act, as presently in effect.

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 beneficially owns, or

will beneficially own (as determined pursuant to Rule 13d-3 under the Exchange Act without regard for the number of days in which a Person has the right to acquire such beneficial ownership, and without regard to Share Acquiror's rights under this Agreement), any securities of the Company.

5.10 United States Person. The Investor is a United States person (as defined by Section 7701(a)(30) of the U.S. Internal Revenue Code of 1986, as amended).

5.11 No General Solicitation. Neither the Share Acquiror nor, to the Share Acquiror's knowledge, any Person acting on behalf of the Share Acquiror has either directly or indirectly, including through a broker or finder (a) engaged in any general solicitation or (b) published any advertisement in connection with the offer and issuance of the Shares.

6. Lock-Up. From and after the Closing Date and until the date that is six 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 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.

7. Registration Rights**.** In the event the Shares as of the date of this Agreement 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.

8. Miscellaneous.

8.1 Governing Law; Submission to Jurisdiction. This Agreement shall be governed by and construed in accordance with the Laws of the State of Delaware, 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 Court of Chancery of the State of Delaware. Each party hereby irrevocably submits to the 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 Court of Chancery of the State of Delaware 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 8.12 hereof or in such other manner as may be permitted by law, shall be valid and sufficient thereof.

8.2 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.

8.3 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); (c) when sent, if sent by facsimile (provided confirmation of transmission is mechanically or electronically generated and kept on file by the sending party); or (d) 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:

Alexion Pharmaceuticals, Inc.
121 Seaport Boulevard
Boston, MA 02210
Attention: General Counsel
e-mail: ellen.chiniara@alexion.com

with a copy (which shall not constitute notice) to:

Ropes & Gray LLP
Prudential Tower
800 Boylston Street
Boston, MA 02199-3600
Attention: Zachary Blume
Facsimile: 617-951-7050
e-mail: zachary.blume@ropesgray.com

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:

Sidley Austin LLP
1001 Page Mill Road, Building 1, Suite 100
Palo Alto, California 94304
Attention: Sam Zucker
Facsimile: (650) 565-7100
e-mail: szucker@sidley.com

Written confirmation of receipt (ii) given by the recipient of such notice, (iii) mechanically or electronically generated by the sender's facsimile machine containing the time, date and recipient facsimile number or (iii) provided by an overnight courier service shall be rebuttable evidence of personal service, receipt by facsimile or receipt from an overnight courier service in accordance with clause (a), (c) or (d) 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.

8.4 Entire Agreement. This Agreement and the Collaborative 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.

8.5 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.

8.6 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, and (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.

8.7 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.

8.8 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.

8.9 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 facsimile transmission or 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.

8.10 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.

8.11 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).

8.12 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 agreement 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.

8.13 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
Title: President & CEO

Alexion Pharmaceuticals, Inc., a Delaware corporation

By:/s/ Paul Clancy
Name: Paul Clancy
Title: Executive Vice President and Chief Financial Officer

APPENDIX 1

REGISTRATION RIGHTS

1. Resale Registration.

1.1 Within forty-five (45) days following the expiration of the Lockup Period, the Company shall file a Registration Statement on Form S-3 covering the resale of the Shares (the "**Resale Registration Shelf**"). Such Resale Registration Shelf shall include a "final" prospectus, including the information required by Item 507 of Regulation S-K of the Securities Act, as provided by the Share Acquiror. Notwithstanding the foregoing, before filing the Resale Registration Shelf, the Company shall furnish to the Share Acquiror a copy of the Resale Registration Shelf and afford the Share Acquiror an opportunity to review and comment on the Resale Registration Shelf. The Company's obligation pursuant to this Section 1.1 is conditioned upon the Share Acquiror providing the information contemplated in Section 2.

1.2 The Company shall use its reasonable best efforts to cause the Resale Registration Shelf and related prospectuses to become effective as promptly as practicable after filing. The Company shall use its reasonable best efforts to cause such Registration Statement to remain effective under the Securities Act until the earlier of the following: (i) all Shares covered by the Resale Registration Shelf have been sold or (ii) all Shares covered by the Resale Registration Shelf can be sold without affiliate restrictions under Rule 144 of the Securities Act. The Company shall promptly, and within two (2) Business Days after the Company confirms effectiveness of the Resale Registration Shelf with the SEC, notify the Share Acquiror of the effectiveness of the Resale Registration Shelf.

1.3 If the filing, initial effectiveness or continued use of the Resale Registration Shelf 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 Resale Registration Shelf (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 Resale Registration Shelf, if required by law or as may reasonably be requested by the Share Acquiror.

2. Information. The Company may require 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 and the Company may exclude the Share Acquiror from any Resale Registration Statement if the Share Acquiror unreasonably fails to furnish such information within a reasonable time after receiving such request. The

Share Acquiror agrees to furnish such information to the Company and to cooperate with the Company as reasonably necessary to enable the Company to comply with the provisions of this Agreement.

3. Expenses. All expenses incident to the Company's performance of or compliance with this Agreement shall be paid by the Company, including (i) 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, (ii) 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), (iii) all printing, duplicating, word processing, messenger, telephone, facsimile 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), (iv) all fees and disbursements of counsel for the Company and of all independent certified public accountants or independent auditors of the Company and any subsidiaries of the Company (including the expenses of any special audit and comfort letters required by or incident to such performance), (v) Securities Act liability insurance or similar insurance if the Company so desires, (vi) 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, (viii) all fees and expenses of any special experts or other Persons retained by the Company in connection with any registration, and (ix) 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) the issuance by the SEC of any stop order suspending the effectiveness of the Resale Registration Shelf 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, (b) 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 Resale Registration Shelf 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, as applicable, within the meaning of the Securities Act or the Exchange Act, against any losses, claims, damages, or liabilities (joint or several) to which they may become subject under the Securities Act, the Exchange Act or other federal or state law, insofar as such losses, claims, damages or liabilities (or actions in respect thereof) arise out of or are based upon any of the following statements, omissions or violations (collectively a "**Violation**") by the Company: (i) any untrue statement or alleged untrue statement of a material fact contained in the Resale Registration Shelf or incorporated by reference therein, including any prospectus contained therein or any amendments or supplements thereto, (ii) 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 (iii) 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 Resale 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, claim, damage, liability 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, claim, damage, liability 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, claim, damage, liability or action 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 expressly for use in connection with the Resale Registration Shelf.

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, claims, damages or liabilities (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, claims, damages or liabilities (or actions in respect thereto) arise out of or are based upon any of the following statements: (i) any untrue statement or alleged untrue statement of a material fact contained in such registration statement or incorporated reference therein, including any preliminary prospectus or final prospectus contained therein or any amendments or supplements thereto, (ii) 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 (iii) any violation or alleged violation by the Company of the Securities Act (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 Acqurior 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, claim, damage, liability 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, claim, damage, liability or action if such settlement is effected without the Share Acquiror's consent.

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, claims, damages or liabilities 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, claim, damage or liability 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) that resulted in such loss, claim, damage or liability, 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.

5.5 The obligations of the Company and the Share Acquior under this Section 5 will survive termination of this Agreement and the expiration or withdrawal of the Resale Registration Shelf. 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.

EXECUTION VERSION

***Text Omitted and Filed Separately with the Securities and Exchange Commission. Confidential Treatment Requested Under 17 C.F.R. Sections 200.80(b)(3) and 240.24b-2

Exhibit 10.36

COLLABORATION AND LICENSE AGREEMENT

between

ELI LILLY AND COMPANY

and

DICERNA PHARMACEUTICALS INC.

together with

DICERNA CAYMAN

October 25, 2018

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COLLABORATION AND LICENSE AGREEMENT

THIS COLLABORATION AND LICENSE AGREEMENT (the "**Agreement**"), effective as of October 25, 2018 (the "**Effective Date**"), is by and between **ELI LILLY AND COMPANY** , a corporation organized and existing under the laws of Indiana, with its principal business office located at Lilly Corporate Center, Indianapolis, Indiana 46285, U.S.A. ("**Lilly**"), 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 87 Cambridgepark Drive, Cambridge, Massachusetts 02140, U.S.A. ("**Dicerna US**"), and **DICERNA CAYMAN**, an exempted company incorporated with limited liability under the laws of the Cayman Islands ("**Dicerna Cayman**" and, collectively with Dicerna US, "**Dicerna**"), on the other hand. Dicerna and Lilly are each referred to individually as a "**Party**" and together as the "**Parties**".

BACKGROUND

A. Lilly is engaged in the research, development, manufacturing, marketing and distribution of pharmaceutical products for use in humans and animals.

B. Dicerna has developed a subcutaneous RNAi platform targeting hepatocytes in the liver using GalXC Molecules (as defined below) to silence mRNA molecules in hepatocyte targets, and using that platform has demonstrated initial knock-down in murine models. Dicerna also has available tool compounds for certain targets which are expected to have application in the treatment of cardiometabolic indications.

C. Dicerna's platforms and know-how may also be useful in the development of other RNAi or oligonucleotide technologies with targeting mechanisms binding to or intended to bind to and induce an inhibition, disruption or modulation of mRNA in Non-Hepatocyte Targets (as defined below).

D. Lilly and Dicerna desire to enter into this Agreement to allow Lilly to access Dicerna's GalXC Platform for certain hepatocyte targets and engage in a collaborative research program for the joint development of New Nucleic Acid Platforms to identify multiple lead candidate targets, designated by Lilly, from which a product could be selected, in each case, on terms set forth in this Agreement.

E. Lilly desires to obtain certain exclusive and nonexclusive licenses from Dicerna to support the activities conducted pursuant to the research program and to enable Lilly to commercialize certain products derived from or containing compounds developed pursuant to this Agreement, and Dicerna is willing to grant such rights to Lilly subject to the terms and conditions as set forth below.

F. Concurrently with the entering into of this Agreement, Dicerna and Lilly are entering into that certain Share Issuance Agreement (the "Share Issuance Agreement"), pursuant to which Lilly is acquiring 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 "**Accounting Firm**" has the meaning set forth in Section 9.5.1.

1.2 "**Acquirer**" has the meaning set forth in Section 1.20(a).

1.3 "**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.

1.4 "**Action**" has the meaning set forth in Section 10.6.5.

1.5 "**Affiliate**" means with respect to either Party, any Person controlling, controlled by or under common control with such Party, for such time as such control exists. For purposes of this Section 1.5 only, "control" means: (a) direct or indirect ownership of fifty percent (50%) or more of the stock or shares having the right to vote for the election of directors or other governing entities of such corporate entity; or (b) the possession, directly or indirectly, of the power to direct, or cause the direction of, the management or policies of such entity, whether through the ownership of voting securities, by contract or otherwise.

1.6 "**Agreement Payments**" has the meaning set forth in Section 9.4.

1.7 "**Alexion-Dicerna Agreement**" has the meaning set forth in Section 1.15.

1.8 "**Alliance Manager**" has the meaning set forth in Section 6.2.

1.9 "**Annual Budget Cap**" has the meaning set forth in Section 4.3.1.

1.10 "**Annual Net Sales**" means, with respect to a particular Product and Calendar Year, all Net Sales of such Product throughout the Territory during such Calendar Year.

1.11 "**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.

1.12 "**Audited Party**" has the meaning set forth in Section 9.5.1.

1.13 "**Auditing Party**" has the meaning set forth in Section 9.5.1.

1.1 "**BI-Dicerna Agreement**" has the meaning set forth in Section 1.15.

1.2 "**Blocked Target**" means those Targets that [***]

1.3 "**Blocked Target List**" has the meaning set forth in Section 2.4.2.

1.4 "**Business Day**" means any day other than a Saturday, Sunday or any other day on which commercial banks in New York, New York, U.S.A. are authorized or required by Applicable Law to remain closed.

1.5 "**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.

1.6 "**Calendar Year**" means each successive period of twelve (12) months commencing on January 1 and ending on December 31.

1.7 "**Change of Control**" means:

(a) with respect to either Party, (i) the acquisition by a Third Party, 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 or consolidation involving such Party, as a result of which a Third Party 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 of all or substantially all of the assets of such Party in one transaction or a series of related transactions to a Third Party, 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 the acquisition of Dicerna by a Lilly Competitor (and Affiliates of such Lilly Competitor which are not subsidiaries of Dicerna), whether in one transaction or a series of related transactions, in addition to the items in (a) above, the acquisition of: (i) majority control of the board of directors or equivalent governing body of Dicerna; (ii) direct or indirect beneficial ownership of more than forty percent (40%) of the outstanding voting equity securities of Dicerna; or (iii) all or substantially all of the assets of Dicerna US or Dicerna Cayman related to the transactions contemplated by this Agreement; in which case such Lilly Competitor and its Affiliates (other than Dicerna and its Affiliates in existence prior to the applicable transaction) shall also be considered an Acquirer.

1.8 "**Claims**" has the meaning set forth in Section 17.1.

1.9 "**Clinical-Phase Supply Agreement**" has the meaning set forth in Section 5.3.1.

1.10 "**Clinical Trial**" means a Phase I Clinical Trial, Phase II Clinical Trial or Phase III Clinical Trial, or any post-approval human clinical trial, as applicable.

1.11 "**Code**" has the meaning set forth in Section 15.5.

1.12 "**Combination Product**" has the meaning set forth in Section 1.110.

1.13 "**Commercial Milestone Event**" has the meaning set forth in Section 8.3.

1.14 "**Commercial Milestone Payment**" has the meaning set forth in Section 8.3.

1.15 "**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.

1.16 [***]

1.17 "**Competing Product**" has the meaning set forth in Section 8.4.4(c).

1.18 "**Competing RNAi Product**" has the meaning set forth in Section 10.6.1.

1.19 "**Compound**" means any compound, product or therapy utilizing, incorporating or based on the GalXC Platform or a New Nucleic Acid Platform, Directed To a Selected Target.

1.20 "**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, whether made available orally, in writing, or in electronic form, 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 Selected 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: (i) Lilly Know-How shall be deemed Confidential Information of Lilly; (ii) Know-How owned or Controlled by Dicerna US or Dicerna Cayman shall be deemed Confidential Information of Dicerna US or Dicerna Cayman, as applicable; (iii) the terms and conditions of this Agreement shall be deemed Confidential Information of both Parties; and (iv) 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 by each of the Parties, 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 or in Article 11 shall restrict either Party from using Joint Know How (it being understood that this shall not limit Sections 3.1 through 3.6 and the exclusive licenses granted to Lilly pursuant to Section 7.1).

1.21 "**Confidentiality Agreement**" has the meaning set forth in Section 19.14.

1.22 "**Confirmed Blocked Target**" has the meaning set forth in Section 3.3.

1.23 "**Control**" or "**Controlled**" means, with respect to any Know-How, or intellectual property right (including any Patent Right), that a Party owns or purports to own, or has a license to, such Know-How or intellectual property right, in each case with 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 without violating any obligations of the granting Party owed to a Third Party or subjecting the granting Party to any additional fee or charge; provided that the Know-How or intellectual property right will be excluded from being considered "Controlled" by virtue of any such fee or charge only if the first Party notifies the other Party of the fee or charge and the other Party does not agree to reimburse the first Party for or otherwise bear the fee or charge. 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 except as expressly set forth in Section 19.2.3 and 19.2.4.

1.24 "**Covered**" or "**Cover**" means, with respect to a Product in a particular country and a particular Patent Right, that the manufacture, use, sale or importation of such Product in such country would, but for the licenses granted herein, infringe an Effective Patent Claim in such Patent Right.

1.25 "**CRO**" has the meaning set forth in Section 4.5.2.

1.26 "**Development**" or "**Develop**" means, with respect to a Compound, Product, or other compound, product or therapy, any non-clinical and clinical drug development activities that are necessary for or used to obtain Marketing Authorization for such Compound, Product, or other compound, product or therapy, including completions of Clinical Trials and 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 Commercialization activities.

1.27 "**Development Milestone Event**" has the meaning set forth in Section 8.2.2.

1.28 "**Development Milestone Payment**" has the meaning set forth in Section 8.2.2.

1.29 "**Dicerna Background IP**" has the meaning set forth in Section 10.3.

1.30 "**Dicerna Indemnified Party**" has the meaning set forth in Section 17.2.

1.31 "**Dicerna Reserved Orphan Neurodegeneration or Pain Target**" has the meaning set forth in Section 3.4.

1.32 "**Diligence Period**" has the meaning set forth in Section 4.4.

1.33 "**Directed To**" means, with regard to an RNAi 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.

1.34 "**Discontinuation Election**" has the meaning set forth in Section 19.2.2(a).

1.35 "**Discontinued Target**" means a Target with [***] pursuant to Sections 2.2.3, 2.3.3, 4.4, 5.4 or 15.2.1, or as to which Lilly has exercised a right of termination under Section 14.2. In case of termination of this Agreement in its entirety by Lilly under Section 14.2 or by Dicerna for cause under Section 14.3 then all Selected Targets shall be considered Discontinued Targets.

1.36 "**Dispute**" has the meaning set forth in Section 19.6.1.

1.37 "**DOJ**" has the meaning set forth in Section 13.1.

1.38 "**Dollar**" means the US dollar, and "$" and "USD" will be interpreted accordingly.

1.39 "**Effective Patent Claim**" means any claim of: (a) an issued and unexpired patent; or (b) a pending patent application; in each case claiming the method of use of a Compound or Product for an approved use of such Product or the composition of matter of a Compound or Product and included within the Licensed Patent Rights (including Product-Specific Patents); in each case which has not been held to be invalid by a Governmental Authority of competent jurisdiction from which no further appeal can be taken.

1.40 "**Eli Lilly and Company Animal Care and Use Requirement for Animal Researchers and Suppliers**" has the meaning set forth in Section 4.8.

1.41 "**Eli Lilly and Company Good Research Practices**" has the meaning set forth in Section 4.8.

1.42 "**Excluded Claim**" has the meaning set forth in Section 19.6.5.

1.43 "**Existing Patents**" has the meaning set forth in Section 16.2.3(a).

1.44 "**Expenses and Payments**" has the meaning set forth in Section 9.5.1.

1.45 "**FDA**" means the United States Food and Drug Administration and any successor thereto.

1.46 "**FFDCA**" has the meaning set forth in Section 16.1.5.

1.47 "**Field**" means any and all uses and purposes, including diagnostic, therapeutic or prophylactic uses in humans or animals for any use, including any use for cardiometabolic indications, Neurodegeneration or Pain Indications, and those indications arising out of the Research Program.

1.48 "**First Commercial Sale**" means the first sale of a Product by Lilly, or one of its Affiliates or their sublicensees, to an unaffiliated third party 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 Lilly or between such entities and a sublicensee of Lilly or an Affiliate, provided a subsequent sale to an unaffiliated Third Party by such Affiliate of Lilly or sublicensee is not considered an intercompany transfer; nor (iii) other similar non-commercial sales.

1.49 "**FTC**" has the meaning set forth in Section 13.1.

1.50 "**FTE**" means, with respect to a person, the equivalent of the work of one (1) employee full time for one (1) year (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 Dicerna 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.

1.51 "**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 beginning on January 1, 2020 to reflect percentage increase in the Consumer Price Index for the US City Average (all times) for 2019 and similarly calculated year to year increases each subsequent Calendar Year. The

FTE Rate shall include costs of salaries, benefits, supplies, other employee costs, and supporting overhead and general and administration allocations.

1.52 "**GalXC Molecule**" means an extended RNAi molecule conjugated to one or more GalNAc ligands.

1.53 "**GalXC Patents**" has the meaning set forth in Section 10.6.1.

1.54 "**GalXC Platform**" means the RNAi technology platform, Controlled by Dicerna, which targets hepatocytes in the liver using GalXC Molecules to silence mRNA molecules in hepatocyte targets.

1.55 "**Gatekeeper**" has the meaning set forth in Section 2.4.1.

1.56 "**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.

1.57 "**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.

1.58 "**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.

1.59 "**Good Research Practices**" or "**GRP**" means research practices consistent with (a) the research quality standards defining how Lilly's research laboratories conduct good science for non-regulated work as set forth in Exhibit A of this Agreement; and (b) the Research Quality Association (RQA), 2014 Quality in Research Guidelines for Working in Non-Regulated Research.

1.60 "**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.

1.61 "**Government Official**" has the meaning set forth in Section 18.5.

1.62 "**Hepatocyte Cardiometabolic Targets**" means, individually or collectively, the Initially Named Targets and the Other Hepatocyte Cardiometabolic Targets.

1.63 "**Hepatocyte Royalty**" has the meaning set forth in Section 8.4.1.

1.64 "**HSR Act**" has the meaning set forth in Section 13.1.

1.65 "**HSR Clearance Date**" has the meaning set forth in Section 13.1.

1.66 "**ICC**" has the meaning set forth in Section 19.6.1.

1.67 "**Improvement**" means any (a) modification, enhancement or change to the Patent Rights or Know-How Controlled by a Party and existing as of or before the Effective Date, (b) Patent Rights claiming the Know-How described in subclause (a), or (c) Patent Rights claiming priority to the Patent Rights included in the Dicerna Background IP, with respect to Dicerna, or the Lilly Background IP, with respect to Lilly.

1.68 "**Initial Blocked Targets**" has the meaning set forth in Section 1.15.

1.69 "**Initial Party**" has the meaning set forth in Section 10.6.6.

1.70 "**Initial Research Collaboration Term**" has the meaning set forth in Section 4.1.2.

1.71 "**IND**" means an investigational new drug application filed with the FDA with respect to a Compound, Product or other compound, product or therapy, 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.

1.72 "**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 [***] days after such submission.

1.73 "**Indemnified Party**" has the meaning set forth in Section 17.3.1.

1.74 "**Indemnifying Party**" has the meaning set forth in Section 17.3.1.

1.75 "**Initially Named Targets**" means the targets [***]

1.76 "**Invention**" means any invention and/or any Know-How, composition of matter, article of manufacture, method of manufacture, method of use or other subject matter, whether patentable or not.

1.77 **"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.

1.78 "**Joint Inventions**" has the meaning set forth in Section 10.4.1.

1.79 "**Joint Know-How**" has the meaning set forth in Section 10.4.1.

1.80 "**Joint Patent Rights**" has the meaning set forth in Section 10.4.1.

1.81 "**JSC**" has the meaning set forth in Section 6.4.1.

1.82 "**JSC Chair**" has the meaning set forth in Section 6.4.1.

1.83 "**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.

1.84 "**Lead Product**" has the meaning Set forth in Section 4.2.2.

1.85 "**Lead Product Non-Clinical and Manufacturing Activities**" has the meaning set forth in Section 4.2.3.

1.86 "**Licensed Know-How**" means all Know-How that is Controlled by Dicerna (or one of its Affiliates) and that is: (a) existing as of the Effective Date, and Improvements thereto, that are necessary or reasonably useful for the Research, Development, registration, manufacture (including formulation), use or Commercialization of a Product in the Field (which would include all Know-How relating to the GalXC Platform); or (b) conceived, developed, created, made or reduced to practice in the course of performing the Research Program during the Term, including Dicerna's rights in any Joint Know-How and any Improvements to the foregoing Know-How described in subclause (b).

1.87 "**Licensed Patent Rights**" means any and all Patent Rights that are Controlled by Dicerna (or one of its Affiliates) and that are: (a) listed in Exhibit E, (b) existing as of the Effective Date, and Improvements thereto, that are necessary or reasonably useful for the Research, Development, registration, manufacture (including formulation), use or Commercialization of a Product in the Field (which would include all Patents directed to the GalXC Platform), or (c) directed

to Know-How described in subclause (b) of the definition of "Licensed Know-How," including Dicerna's rights in any Joint Patent Rights and New Platform Patents.

1.88 "**Licensed Technology**" means, individually or collectively, the Licensed Patent Rights and the Licensed Know-How.

1.89 "**Lilly Background IP**" has the meaning set forth in Section 10.2.

1.90 "**Lilly Competitor**" means a [***]

1.91 "**Lilly Indemnified Party**" has the meaning set forth in Section 17.1.

1.92 "**Lilly Intellectual Property**" means, individually or collectively, Lilly Background IP, Lilly Patents and Lilly Know-How.

1.93 "**Lilly Know-How**" means any and all Know-How Controlled by Lilly (or one of its Affiliates) that is: (a) existing as of the Effective Date or generated or acquired outside the scope of the Research 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 Research Program during the Term, including Lilly's rights in any Joint Know-How.

1.94 "**Lilly Patents**" means any and all Patents Controlled by Lilly (or one of its Affiliates) that is: (a) existing as of the Effective Date or generated or acquired outside the scope of the Research 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 "Lilly Know-How," including Lilly's rights in any Joint Patent Rights.

1.95 "**Losses**" has the meaning set forth in Section 17.1.

1.96 "**Marketing Authorization**" means, collectively, all Regulatory Approvals (including any pricing, reimbursement or access approvals) from the relevant Regulatory Authority necessary to initiate marketing and selling a Product in any country or jurisdiction.

1.97 "Net Sales" [***]

(a) [***]

(b) [***]

(c) [***]

(d) [***]

(e) [***]

(f) [***]

(g) [***]

(h) [***]

[***]

[***]

[***]

[***]

[***]

[***]

[***]

1.98 "**Neurodegeneration or Pain Indication**" means an indication for which the Compound is designed to [***].

1.99 "**Neurodegeneration or Pain Response Notice**" has the meaning set forth in Section 3.3.

1.100 "**New Nucleic Acid Platform**" means any new RNAi or oligonucleotide technology platform, [***]. As used in this Agreement, "**New Nucleic Acid Platform**" includes and may individually or collectively refer to a "**New Platform for Non-Hepatocyte Cardiometabolic Targets**" or a "**New Platform for Non-Hepatocyte Neurodegeneration/Pain Targets**," as applicable.

1.101 "**New Platform for Non-Hepatocyte Cardiometabolic Targets**" means an RNAi or oligonucleotide technology platform developed by either Lilly or Dicerna (or both) pursuant to this Agreement and the Research Plan, intended to be used in the Development of Compounds Directed To Non-Hepatocyte Cardiometabolic Targets.

1.102 "**New Platform for Non-Hepatocyte Neurodegeneration/Pain Targets**" means an RNAi or oligonucleotide technology platform developed by Lilly or Dicerna (or both) pursuant to this Agreement and the Research Plan, intended to be used in the Development of Compounds Directed To Non-Hepatocyte Neurodegeneration/Pain Targets.

1.103 "**New Platform Negotiation Expiration Date**" has the meaning set forth in Section 3.6.1(a).

1.104 "**New Platform Patents**" has the meaning set forth in Section 10.6.2.

1.105 "**Non-Hepatocyte Cardiometabolic Targets**" has the meaning set forth in Section 2.1.1(b).

1.106 "**Non-Hepatocyte Neurodegeneration/Pain Targets**" has the meaning set forth in Section 2.1.1(c).

1.107 "**Non-Hepatocyte Royalty**" has the meaning set forth in Section 8.4.2.

1.108 "**Non-Hepatocyte Targets**" has the meaning set forth in Section 2.1.1(c).

1.109 "**Notice of Dispute**" has the meaning set forth in Section 19.6.1.

1.110 "**Orphan Indication**" means an indication for use of a drug to treat a rare disease or condition 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 Federal Food, Drug, and Cosmetic Act and 21 C.F.R. 316.21.

1.111 "**Other Hepatocyte Cardiometabolic Targets**" has the meaning set forth in Section 2.1.1(a).

1.112 "**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.

1.113 "**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, including all provisional applications, substitutions, continuations, 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.

1.114 "**Payee**" has the meaning set forth in Section 9.4.

1.115 "**Payor**" has the meaning set forth in Section 9.4.

1.116 "**Permitted Subcontractors**" has the meaning set forth in Section 4.9.

1.117 "**Person**" means any individual, corporation, partnership, association, joint-stock company, trust, unincorporated organization or government or political subdivision thereof.

1.118 "**Phase I 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.

1.119 "**Phase II 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.

1.120 "**Phase III 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.

1.121 "**POP Data Package**" has the meaning set forth in Section 2.3.4.

1.122 "**Product**" means any Compound selected by Lilly pursuant to Section 4.2.2 or Section 4.3.3 for subsequent Development after Proof of Principle.

1.123 "**Product Payment Amounts**" has the meaning set forth in Section 3.6.1(a).

1.124 "**Product-Specific Patents**" has the meaning set forth in Section 10.6.3.

1.125 "**Program Inventions**" has the meaning set forth in Section 10.1.

1.126 "**Project Leader**" has the meaning set forth in Section 6.1.

1.127 "**Proof of Principle**" means: [***]

1.128 "**Records**" has the meaning set forth in Section 4.7.1.

1.129 "**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.

1.130 "**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.

1.131 "**Regulatory Documentation**" has the meaning set forth in Section 16.2.7.

1.132 "**Research**" means all activities related to the research, identification, generation, formatting, screening, testing (including in vitro and animal models, but not in human subjects), stability testing, toxicology and formulation of compounds, products or therapies.

1.133 "**Research Collaboration Term**" has the meaning set forth in Section 4.1.2.

1.134 "**Research Plan**" has the meaning set forth in Section 4.1.3.

1.135 "**Research Program**" has the meaning set forth in Section 4.1.1.

1.136 "**Reserved Targets**" has the meaning set forth in Section 2.1.1.

1.137 "**Returned Compounds and Products**" has the meaning set forth in Section 15.2.1.

1.138 "**Royalty**" has the meaning set forth in Section 8.4.2.

1.139 "**Royalty Term**" has the meaning set forth in Section 8.4.3.

1.140 "**Selected Target(s)**" means Targets selected by Lilly for inclusion in the Research Program pursuant to Section 2.2, including both Initially Named Targets and Substitute Targets, but specifically excluding Discontinued Targets.

1.141 The "**Selection Period**" during which Lilly may select Selected Targets means: [***]

1.142 "**Shared Development Milestone Event**" has the meaning set forth in Section 8.2.2.

1.143 "**Substitute Target(s)**" has the meaning set forth in Section 2.3.3.

1.144 "**Target**" means: [***]

1.145 "**Taxes**" has the meaning set forth in Section 9.4.

1.146 "**Term**" has the meaning set forth in Section 14.1.

1.147 "**Territory**" means all of the countries and territories in the world.

1.148 "**Third Party**" means any Person other than Lilly or Dicerna or an Affiliate of Lilly or Dicerna.

1.149 "**United States**" or "**US**" means the United States of America and its territories and possessions.

1.150 "**Upfront Cash Payment**" has the meaning set forth in Section 8.1.1.

1.151 "**US GAAP**" has the meaning set forth in Section 1.110(h).

1.152 "**Working Group**" has the meaning set forth in Section 6.3.

2. TARGET RESERVATION AND SELECTION

2.1 Target Reservation.

2.1.1 Reserved Targets. Promptly after the Effective Date, but in no event later than [***] after the Effective Date, the Parties shall enter into an agreement with the initial Gatekeeper that meets the criteria under Section 2.4.1. Dicerna shall promptly thereafter provide such Gatekeeper a list of all of its Blocked Targets, which may be modified from time to time pursuant to Section 2.4.2. During the Research and Collaboration Term, Lilly may identify to the Gatekeeper up to the following number of Targets that Lilly wishes to reserve for potential selection for further Development pursuant to the Research Program (such Targets individually and collectively referred to as "**Reserved Targets**"), subject to Section 2.1.3:

(a) up to [***] potential hepatocyte Targets, other than the Initially Named Targets, expected to have applications in the treatment of cardiometabolic indications ("**Other Hepatocyte Cardiometabolic Targets**");

(b) up to [***] non-hepatocyte Targets expected to have applications in the treatment of cardiometabolic indications ("**Non-Hepatocyte Cardiometabolic Targets**"); and

(c) such other non-hepatocyte targets [***] selected by Lilly expected to have applications in the treatment of Neurodegeneration or Pain Indications ("**Non-Hepatocyte Neurodegeneration/Pain Targets**" and, together with the Non-Hepatocyte Cardiometabolic Targets, the "**Non-Hepatocyte Targets**").

Lilly shall submit its initial list of Reserved Targets within [***] after the Effective Date, and thereafter may, in its discretion, substitute another Target for any Reserved Target provided that at the time of such substitution such substituted Target is not a Blocked Target.

2.1.2 Increases to Non-Hepatocyte Cardiometabolic Reserved Targets. Notwithstanding the numbers of Reserved Targets set forth in Section 2.1.1, Lilly shall also have the right, in its sole discretion and by written notice to Dicerna, at any time during the applicable Selection Period, to increase the number of Non-Hepatocyte Cardiometabolic Targets it reserves as Reserved Targets, up to a maximum of [***] Non-Hepatocyte Cardiometabolic Targets, provided that: (a) any increase to the number of Non-Hepatocyte Cardiometabolic Targets that Lilly may reserve as a Reserved Target shall simultaneously decrease the number of Other Hepatocyte Cardiometabolic Targets that Lilly may reserve as a Reserved Target by an equal number (for example, an increase in Non-Hepatocyte Cardiometabolic Targets by [***], would result in a decrease in the number of Other Hepatocyte Cardiometabolic Targets by [***]) and (b) selection of any Target would be subject to Section 2.1.3 and the Gatekeeper process described in Section 2.4.

2.1.3 Any Targets submitted by Lilly after the Effective Date to be included as a Reserved Target will be subject to confirmation of their availability by Dicerna through the Gatekeeper process described in Section 2.4.

2.2 Target Selection.

2.2.1 Selected Targets. During the applicable Selection Period, Lilly shall have the right to select from the Reserved Targets:

(a) up to [***] Other Hepatocyte Cardiometabolic Targets;

(b) up to [***] Non-Hepatocyte Cardiometabolic Targets; and

(c) such initial Non-Hepatocyte Neurodegeneration/Pain Targets as may be selected by Lilly, plus such additional Targets as may be recommended by Lilly and accepted by the JSC.

2.2.2 Increases to Non-Hepatocyte Cardiometabolic Selected Targets. Notwithstanding the numbers of Selected Targets set forth in Section 2.2.1, during the applicable Selection Period, Lilly shall also have the right, in its sole discretion and by written notice to Dicerna, to increase the number of Non-Hepatocyte Cardiometabolic Targets it may select from the Reserved Targets, up to a maximum of [***] Non-Hepatocyte Cardiometabolic Targets; provided that: (a) any increase to the number of Non-Hepatocyte Cardiometabolic Targets that Lilly may select from the Reserved Targets shall simultaneously decrease the number of Other Hepatocyte Cardiometabolic Targets it may select by an equal number (for example, an increase in Non-Hepatocyte Cardiometabolic Targets by [***] would result in a decrease in the number of Other Hepatocyte Cardiometabolic Targets by [***]) and (b) selection of any Target that is not on the Reserved Target list at the time of such requested increase would be subject to the Gatekeeper process described in Section 2.4.

2.2.3 Non-Selected Targets. Upon the expiration of the Selection Period with respect to a particular category of Target (*i.e.*, Other Hepatocyte Cardiometabolic Target, Non-Hepatocyte Cardiometabolic Target or Non-Hepatocyte Neurodegeneration/Pain Target), the remaining Targets in that category that are not Selected Targets shall become Discontinued Targets, subject to Section 15.2, but remaining subject to Section 3.3.

2.3 Target Substitution.

2.3.1 Substitute Targets. If, at any point during the applicable Research Collaboration Term, Lilly determines, after consultation with the JSC, that it wishes to substitute a Target, whether from the Reserved Target list or otherwise, for a Selected Target, Lilly shall have the right to make such Target substitution within [***] following such determination by providing written notice to Dicerna of such substitution; provided that Lilly's foregoing right to substitute a Target for a Selected Target shall not exceed [***] substitutions in total for cardiometabolic Selected Targets (*i.e.*, that are Initially Named

Targets, Hepatocyte Cardiometabolic Targets or Non-Hepatocyte Cardiometabolic Targets), and up to [***] substitutions in total for Non-Hepatocyte Neurodegeneration/Pain Targets.

2.3.2 Confirmation of Availability of Substitute Target. Any Target which Lilly would like to substitute for existing Targets as described in this Section 2.3 will be subject to confirmation of their availability by Dicerna through the Gatekeeper process described in Section 2.4. For avoidance of doubt, if a Target that Lilly seeks to reserve is a Blocked Target at the time Lilly seeks reservation, Lilly may designate a different Target in its place and such designation shall not be considered a substitution subject to this Section 2.3.

2.3.3 Effects of Target Substitution. If any Targets are substituted for a Selected Target in accordance with the foregoing (each, a "**Substitute Target**") such Substitute Target shall be automatically deemed a Selected Target under this Agreement, and the Selected Target that such Target substituted shall be deemed a Discontinued Target and subject to the provisions of Section 15.2. In addition, the Parties shall update the Research Plan as necessary to reflect such substitution of the Substitute Target for the Discontinued Target.

2.3.4 Costs Relating to Target Substitutions. [***]

2.4 Gatekeeper Process.

2.4.1 Gatekeeper. The Parties will agree on an independent attorney nominated by Lilly and reasonably acceptable to Dicerna to act as an information gatekeeper (the "**Gatekeeper**") through which Lilly may inquire as to whether any Target that Lilly intends to designate as a Selected Target (whether pursuant to Section 2.2.1 or Section 2.3.1) is a Blocked Target at that time; and through which Dicerna may inquire as to whether any Target with respect to which Dicerna intends to engage in activities that may be restricted under Section 3.1 is a Reserved Target at that time. Dicerna and Lilly 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 11 and prohibits the Gatekeeper from disclosing to Dicerna the identity of a Target that was the subject of any inquiry and the list of Reserved Targets. Nothing in this Section 2.4.1 will preclude Lilly from contacting Dicerna directly regarding the availability of Targets or otherwise, to which Dicerna will respond in its discretion or Dicerna from contacting Lilly directly regarding whether a particular Target is a Reserved 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.

2.4.2 Gatekeeper Procedures. At the Effective Date Dicerna shall provide to the Gatekeeper the list of Initial Blocked Targets and from time to time thereafter (including at least once per Calendar Quarter, including in response to inquiries hereunder), (a) Dicerna will provide the Gatekeeper with a current list of all Blocked Targets, together with any applicable rights Dicerna can still grant hereunder with respect to such Blocked Targets, and any associated restrictions (such list of Blocked Targets, together with the Initial Blocked

Targets, the "**Blocked Target List**"), and (b) Lilly will be entitled to, at its discretion submit inquiries to the Gatekeeper. Upon receipt of an inquiry, the Gatekeeper will notify Dicerna of such inquiry by Lilly without disclosing the subject Target, after which Dicerna will have [***] to provide the Gatekeeper with any updates to the Blocked Target List. The Gatekeeper will inform Lilly in writing whether the subject Target is a Blocked Target within [***] of receipt of the associated inquiry and, if the Target is a Target as to which Dicerna can still grant rights to Lilly, the Gatekeeper will inform Lilly of the availability of such Target and what rights Dicerna can grant and any associated restrictions. If the Gatekeeper notifies Lilly in response to an inquiry (or Dicerna notifies Lilly, in the case of direct contact between the Parties) that a Target is a Blocked Target, Lilly 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 Lilly and rejected by the Gatekeeper, the Gatekeeper shall be under an obligation to notify Lilly of such change as soon as practicable. Dicerna may from time to time inquire as to whether any Target with respect to which Dicerna intends to engage in activities that may be restricted under Section 3.1 is a Reserved Target. Upon receipt of such an inquiry from Dicerna, the Gatekeeper will inform Dicerna in writing whether the subject Target is a Reserved Target within [***] of receipt of the associated inquiry.

3. EXCLUSIVITY

3.1 Reserved Target Exclusivity – [***], with respect to each Reserved Target, Dicerna and its Affiliates shall be exclusive to and work exclusively with Lilly on each such Reserved Target. In connection with the foregoing, other than as may be incidental to research activities for Targets other than Reserved Targets, and except as may be permitted under Section 19.1 or as Dicerna may be permitted to delegate its obligations to a Third Party subcontractor pursuant to Section 4.9, Dicerna shall not (by itself nor with any Third Party) and shall cause its Affiliates not to (by themselves nor with any Third Party):

(a) carry out Research, Development or Commercialization with respect to such Reserved Targets (or compounds, products or therapies that are Directed To such Reserved Target); or

(b) sell, assign, transfer, convey, license, sublicense, covenant not to assert or otherwise grant or transfer, to any Third Party, any rights or immunities to or under any Licensed Technology to carry out such Research, Development or Commercialization (described in (a) above) on any Reserved Target;

in each case, until such time, if any, that the Reserved Target becomes a Discontinued Target.

In addition, during the Selection Period, with respect to each Reserved Target, Dicerna shall not enter into any agreement or take any action that would preclude its ability to extend Lilly the rights granted hereunder and otherwise perform should Lilly select such Reserved Target (which has not become a Discontinued Target) as a Selected Target.

3.2 Selected Target Exclusivity – Term of Agreement. During the Term of this Agreement, with respect to each Selected Target, Dicerna shall be exclusive to and work exclusively with Lilly on each such Selected Target. In connection with the foregoing, other than as may be incidental to research activities for Targets other than Reserved Targets, and except as may be permitted under Section 19.1 or as Dicerna may be permitted to delegate its obligations to a Third Party subcontractor pursuant to Section 4.9, Dicerna shall not (by itself nor with any Third Party) and shall cause its Affiliates not to (by themselves nor with any Third Party):

(a) carry out Research, Development or Commercialization with respect to the Selected Targets (or compounds, products or therapies that are Directed To such Selected Targets); or

(b) sell, assign, transfer, convey, license, sublicense, covenant not to assert or otherwise grant or transfer, to any Third Party, any rights or immunities to or under any Licensed Technology to carry out such Research, Development or Commercialization (described in (a) above) on any Selected Target;

in each case, until, with respect to a particular Selected Target, such time, if any, that the Selected Target becomes a Discontinued Target.

3.3 Exclusivity for Compounds, Products or Therapies in Neurodegeneration or Pain Indications. [***]

3.4 [***]

3.5 No Exclusivity to Lilly. For avoidance of doubt, nothing in this Agreement shall restrict the ability of Lilly or its Affiliates to Research, Develop or Commercialize any compounds, products or therapies, it being understood that this Section 3.5 shall not be deemed to expand the scope of any licenses to Licensed Technology granted hereunder. Notwithstanding the foregoing, if Lilly wishes to Research, Develop or Commercialize, through itself or any Affiliate or Third Party, any RNAi or oligonucleotide product based on the GalXC Platform, such Research, Development or Commercialization shall be done in collaboration with Dicerna under this Agreement.

3.6 Limitations on Use of New Nucleic Acid Platform. Without limiting Sections 3.1 through 3.4 and the exclusive licenses granted to Lilly pursuant to Section 7.1:

3.6.1 If Lilly or its Affiliate wishes to Develop or Commercialize with a Third Party licensor or collaboration partner (not including, for avoidance of doubt, any subcontractor performing services for Lilly), at any time within the first [***] following the end of the Research Collaboration Term, any RNAi or oligonucleotide product based on a New Nucleic Acid Platform directed to a Non-Hepatocyte Neurodegeneration/Pain Target or a Non-Hepatocyte Cardiometabolic Target (a "**New Platform Third Party Collaboration**"), the following shall apply:

(a) Prior to Lilly entering into a New Platform Third Party Collaboration, Lilly shall discuss in good faith with Dicerna the possibility of entering into a collaboration with Lilly for such Development or Commercialization,

with such product [***] If the Parties are unable to reach an agreement with respect to such collaboration within [***] following Lilly's request (the "**New Platform Negotiation Expiration Date**"), Lilly shall be free to carry out such Development or Commercialization with any Third Party, subject to Section 3.6.1(b).

(b) If Lilly or its Affiliate is conducting such Development or Commercialization pursuant to a New Platform Third Party Collaboration and (i) if GLP toxicology studies have been initiated for the subject product of Lilly or its Affiliate within the first [***] following the end of the Research Collaboration Term, then Lilly shall pay to Dicerna [***] of the Product Payment Amounts for such product and (ii) if such GLP toxicology studies have been initiated within the period beginning the day following the end of the [***] after the end of the Research Collaboration Term but prior to the end of the [***] after the end of the Research Collaboration Term, then Lilly shall pay to Dicerna [***] of the Product Payment Amounts for such product. If no such GLP toxicology studies have been initiated prior to the end of the [***] after the end of the Research Collaboration Term no such payments shall be due from Lilly to Dicerna.

3.6.2 If Lilly or its Affiliate Develops or Commercializes without a New Platform Third Party Collaboration, at any time within the [***] following the end of the Research Collaboration Term, any RNAi or oligonucleotide product based on a New Nucleic Acid Platform directed to a Non-Hepatocyte Neurodegeneration/Pain Target or a Non-Hepatocyte Cardiometabolic Target, and (i) if GLP toxicology studies have been initiated for the subject product of Lilly or its Affiliate within the first [***] following the end of the Research Collaboration Term, then Lilly shall pay to Dicerna [***] of the Product Payment Amounts for such product and (ii) if such GLP toxicology studies have been initiated within the period beginning the day following the end of the [***] but prior to the end of the [***] after the end of the Research Collaboration Term, then Lilly shall pay to Dicerna [***] of the Product Payment Amounts for such product. If no such GLP toxicology studies have been initiated prior to the end of the [***] after the end of the Research Collaboration Term no such payments shall be due from Lilly to Dicerna.

For purposes of Sections 3.6.1(b) and 3.6.2 only, the Product Payment Amounts relating to the Development Milestone Events for [***] shall be combined and the specified percentage of such Product Payment Amount shall be due if and only if the Development Milestone Event for the [***] occurs.

3.7 No Further Restrictions. Without limiting Sections 3.1 through 3.6 and the exclusive licenses granted to Lilly pursuant to Section 7.1, each Party shall otherwise be free to exploit each New Nucleic Acid Platform. For example, (i) if the New Nucleic Acid Platform has applications outside of Non-Hepatocyte Neurodegeneration/Pain Targets or Non-Hepatocyte Cardiometabolic Targets, both Parties, subject to Sections 3.1 through 3.6 and the exclusive licenses granted to Lilly pursuant to Section 7.1, shall be free to exploit such New Nucleic Acid Platform for such purposes; and (ii) both Parties, subject to Sections 3.1 through 3.4 and the exclusive licenses granted to Lilly pursuant to Section 7.1, shall be unrestricted with respect to each New Nucleic

Acid Platform from and after [***] following the end of the Research Collaboration Term. Each of the Parties acknowledges the contributions the other Party is making to the development of the New Nucleic Acid Platform and, from time to time, each Party may discuss, in its sole discretion, with the other Party the possibility of entering into a collaboration for Development and Commercialization of a product based on a New Nucleic Acid Platform outside of a Neurodegeneration or Pain Indication or cardiometabolic indication.

4. RESEARCH PROGRAM

4.1 Research Program.

4.1.1 Purpose. During the Research Collaboration Term, Lilly and Dicerna shall engage in a collaborative research development program with the goal of Researching and Developing multiple lead candidates Directed To each of the Selected Targets from which one or more Compounds or Products could be selected, and the development of an RNAi or oligonucleotide technology platform targeting Non-Hepatocyte Cardiometabolic Targets or Non-Hepatocyte Neurodegeneration/Pain Targets, as applicable; in each case based on the specified activities, timelines, budget and criteria set forth in an applicable Research Plan (the "**Research Program**").

4.1.2 Research Collaboration Term. The Research Program shall be conducted over a term commencing on the Effective Date and continuing for a period of [***] thereafter (the "**Initial Research Collaboration Term**"), provided that: (a) with respect to any particular Selected Target that is the subject of active development at the end of the Initial Research Collaboration Term, the term shall be extended until achievement of Proof of Principle for a Compound Directed To that Selected Target or, in the case of the Lead Product, through [***] subject, in case of Non-Hepatocyte Targets, to Sections 4.3 and 4.5.1; and (b) with respect to Non-Hepatocyte Targets, Lilly may extend the term at its option, following consultation with the JSC, for up to [***] consecutive [***] periods to facilitate the continued development of the New Platform for Non-Hepatocyte Cardiometabolic Targets and New Platform for Non-Hepatocyte Neurodegeneration/Pain Targets, respectively (the Initial Research Collaboration Term plus any such extensions, the "**Research Collaboration Term**").

4.1.3 Research Plan. All Research and pre-clinical Development activities of each Party occurring during the Research Collaboration Term and the timelines for all Targets and budgets therefor shall be set forth in one or more mutually agreed upon Research Plans, with the initial Research Plan for the Initially Named Targets attached hereto on Exhibit B and as may be amended from time to time in accordance with the terms of this Agreement (each, a "**Research Plan**"). For clarity, the budgets to be set forth in the Research Plan(s) shall be construed only as guidelines and shall not in any way limit Dicerna's obligation to use Commercially Reasonable Efforts to perform its activities specified in the Research Plan, subject to Dicerna's rights of reimbursement and limitations of Dicerna's responsibilities expressly set forth in this Article 4.

4.2 Hepatocyte Targets – Compound and Product Development.

4.2.1 Development through Proof of Principle. For Selected Targets that are Initially Named Targets or Other Hepatocyte Cardiometabolic Targets, Dicerna shall use Commercially Reasonable Efforts to conduct activities specified in the Research Plan directed toward establishing, up through Proof of Principle, Compound and Product candidates suitable for advancement into human Clinical Trials. Lilly shall not be required to conduct any Research or Development efforts with respect to Compounds Directed To Initially Named Targets or Other Hepatocyte Cardiometabolic Targets prior to Proof of Principle.

4.2.2 Selection of Lead Product and Designation of other Products. Lilly shall be entitled to select one "**Lead Product**" that is a Compound achieving Proof of Principle that is Directed To an Initially Named Target and designate one or more other Compounds achieving Proof of Principle as "Products" to be further Developed hereunder. Lilly may make such selection or designation at any time by written notice to Dicerna. For a period of up to [***] following the first Compound achieving Proof of Principle, Dicerna shall continue, at Dicerna's expense, development of each Compound achieving Proof of Principle while Lilly determines which (if any) Compound Lilly wishes to select as the Lead Product.

4.2.3 Further Development of Lead Product. Following achievement of Proof of Principle for the Lead Product and selection of the Lead Product by Lilly, Dicerna shall, as further described in the Research Plan, also use Commercially Reasonable Efforts to manage the toxicology program and manufacturing of clinical supply through IND Approval and the initial Phase 1 Clinical Trial for the Lead Product ("**Lead Product Non-Clinical and Manufacturing Activities**"), at Dicerna's cost, based on the responsibilities, specific activities, budget and timelines as agreed in the Research Plan unless the JSC determines that IND Approval will, more likely than not, be unavailable or that obtaining IND Approval would require efforts on behalf of Dicerna that are beyond Commercially Reasonable Efforts. Except as expressly provided and agreed otherwise in the Research Plan for the Lead Product, Lilly shall not be required to conduct any Research or Development efforts for the Lead Product that are included in the Lead Product Non-Clinical or Manufacturing Activities prior to IND Approval, provided that that Lilly shall be responsible to prepare and submit the IND filing and seek IND Approval as further described in Section 4.6.

4.2.4 Further Development of Other Products. For all Products Directed To Initially Named Targets or Other Hepatocyte Cardiometabolic Targets other than the Lead Product, the JSC shall develop a Research Plan including activities beyond Proof of Principle through IND Approval and shall determine the allocation of responsibilities between Dicerna and Lilly for each Product, provided that, subject to Section 4.2.3, such activities beyond Proof of Principle through IND Approval shall be at Lilly's cost and in no case shall Dicerna's responsibilities exceed those for the Lead Product unless agreed upon by the Parties and set forth in a Research Plan.

4.3 Non-Hepatocyte Targets – Platform, Compound and Product Development.

4.3.1 For Non-Hepatocyte Targets, the Parties shall work together through the JSC to create a Research Plan during the Initial Research Collaboration Term to develop the New Platform for Non-Hepatocyte Cardiometabolic Targets or the New Platform for Non-Hepatocyte Neurodegeneration/Pain Targets, as applicable, based on the activities, timelines, budget and criteria specified and as set forth in the Research Plan, and provided that the total expenses for such activities to be performed by Dicerna shall not exceed [***] per calendar year for the first [***] of Initial Research Collaboration Term (the "**Annual Budget Cap**"), with the understanding that if such expenses in any given calendar year are below that year's Annual Budget Cap, the difference shall be carried forward to the following year and added to the following year's Annual Budget Cap (with any shortfall in the [***] calendar year of the Initial Research Collaboration Term being carried forward and recoupable by Lilly against expenses for which Lilly would otherwise be required to reimburse Dicerna for activities covered by the Research Plan in the [***] calendar year of the Initial Research Collaboration Term) and if such expenses in any given calendar year are above that year's Annual Budget Cap, the difference shall reduce the following year's Annual Budget Cap by the amount of such difference. The parties shall discuss in good faith the treatment of any expenses of Dicerna in any given year of the Initial Research Collaboration Term above the Annual Budget Cap.

4.3.2 Once Lilly has selected one or more Non-Hepatocyte Targets as Selected Targets, the Parties shall agree to a Research Plan for each such Non-Hepatocyte Target and the Parties shall use Commercially Reasonable Efforts to conduct the specified activities through Proof of Principle based on the responsibilities, specific activities, budget and timelines as agreed in the Research Plan, with the anticipation that Dicerna shall be responsible for conducting all activities through Proof of Principle (subject to Section 4.5) and Lilly shall not be required to conduct any Research or Development efforts with respect to Compounds Directed To such Targets prior to achievement of Proof of Principle. Such Research Plan shall also include activities beyond Proof of Principle until IND Approval and the JSC shall determine the allocation of responsibilities between Dicerna and Lilly for each Product, but such activities shall be at Lilly's cost, and in no case shall Dicerna's responsibilities exceed those for the Lead Product unless agreed upon by the Parties.

4.3.3 Following the achievement of Proof of Principle for a Compound Directed To a Non-Hepatocyte Cardiometabolic Target or Non-Hepatocyte Neurodegeneration/Pain Target, Lilly may (but is not required to) designate the Compound as a "Product" and if Lilly does so, the JSC shall develop a Research Plan including activities beyond Proof of Principle through IND Approval and shall determine the allocation of responsibilities between Dicerna and Lilly for each Product, but such activities beyond Proof of Principle through IND Approval shall be at Lilly's cost, and in no case shall Dicerna's responsibilities exceed those for the Lead Product unless agreed upon by the Parties.

4.4 Clinical Development Diligence Obligations. Lilly shall use Commercially Reasonable Efforts to conduct all Development activities from IND Approval through Marketing

Authorization for one Product (the "**Diligence Period**"). If, prior to the expiration of the Diligence Period, [***] for more than [***] consecutive months[***]. Under such circumstances, if [***] it shall notify Lilly, and if Lilly disputes [***] days of its receipt of such notice, the dispute shall be resolved pursuant to Section 19.6, provided that Lilly shall be deemed to have [***] if, within [***] days following a determination that it had abandoned the Selected Target, Lilly resumes such engagement. If Lilly fails to respond to a notice from [***] within such [***] day period, or is determined pursuant to Section 19.6 [***] within [***] days following such determination, such Selected Target shall become a Discontinued Target and any Compounds or Products directed to such Discontinued Target shall become Returned Compounds and Products, without any requirement to terminate pursuant to Section 14.3.1. In no event, however, will Lilly be deemed pursuant to this Section 4.4 to have abandoned any Initially Named Targets.

4.5 Costs of Performance.

4.5.1 Responsibilities of Parties. Except as otherwise expressly set forth in this Agreement or in a Research Plan, and subject to Dicerna's Annual Budget Cap, during the Initial Research Collaboration Term, Dicerna and Lilly shall each respectively bear all expenses it incurs in performance of its own activities under this Agreement and the Research Plan. Dicerna shall also be responsible for the cost of all activities through Proof of Principle for the initial Non-Hepatocyte Neurodegeneration/Pain Targets. Notwithstanding the foregoing, Lilly shall be responsible for the cost of any activities conducted by Dicerna as a result of extensions by Lilly of the Initial Research Collaboration Term and the cost of activities for Targets selected in addition to the initial Non-Hepatocyte Neurodegeneration/Pain Targets.

4.5.2 Cost Calculation Mechanism. Where this Agreement requires that Lilly reimburse or be responsible for Dicerna's costs, such costs shall be calculated in accordance with the following mechanism: Lilly shall compensate Dicerna for FTEs performing activities under and in accordance with the Research 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 Lilly. In addition to the FTE Rates, Lilly shall compensate any out of pocket expenses incurred by Dicerna in accordance with the Research Plan or upon written instruction of Lilly. The compensation is to be paid by Lilly to Dicerna on a quarterly basis with respect to each Calendar Quarter. Payment shall be made in arrears and within [***] after receipt of an invoice, with supportive documentation detailing the FTE costs and out of pocket expenses applicable to Dicerna's efforts for such applicable Calendar Quarter period, such information to include the work packages of the Research 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**") costs incurred by Dicerna in accordance with the Research 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 Lilly; provided, that, if Lilly 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 Lilly. 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 Lilly, and in the event there are no further invoices anticipated, reimburse Lilly within [***] of such true up. As long as Dicerna provides Development support to Lilly and for a period [***] thereafter, Dicerna shall maintain complete and accurate books and records regarding the FTEs and all out-of-pocket expenses (including CRO costs) invoiced to Lilly and Lilly 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 Lilly in accordance with Section 9.5 of this Agreement applied *mutatis mutandis* (subject only to replacing references to "Lilly" with references to "Dicerna," and vice versa, and other analogous changes, including changes related to the subject matter of the audit).

4.6 IND Filing; Reconciliation of Defects. For all Products Developed under Section 4.2 or Section 4.3 subject to an IND filing, Lilly 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. Lilly 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 Lilly. If, in the course of pursuing the IND, the applicable Regulatory Authority identifies deficiencies in particular components of the submission, rectifying the deficiencies shall be the responsibility of the Party that was responsible for the applicable components in the course of conducting the Research Plan.

4.7 Records, Reports and Audits.

4.7.1 Dicerna Records of Activities under Research Program. Dicerna shall maintain 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 Research 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 Dicerna in the performance of the Research Program; and sufficient to confirm the accuracy and contents of the Blocked Target List (the "**Records**").

4.7.2 Copies and Inspection of Records. [***]

4.8 Certain Standards Applicable to Work. All Research and Development done by either Party for non-regulated work under this Agreement will be conducted in accordance with the Research Plan, Eli Lilly and Company Good Research Practices, Eli Lilly and Company Animal Care and Use Requirement for Animal Researchers and Suppliers, all applicable data privacy and security laws and regulations and other Applicable Laws. For purposes of this Agreement, "**Eli Lilly and Company Good Research Practices**" means the compiled set of shared research quality standards defining how Lilly's research laboratories conduct good science for non-regulated work as set forth in Exhibit A. For purposes of this Agreement, "**Eli Lilly and Company Animal Care**

and Use Requirement for Animal Researchers and Suppliers" means the guidelines relating to animal care and use for research done on behalf of Lilly as set forth in Exhibit C. [***]

4.9 Dicerna Right to Subcontract. Subject to the terms of this Section 4.9, Dicerna shall have the right to engage permitted Third Party contractors working on its behalf (the "**Permitted Subcontractors**") to perform such portions of its Research obligations under this Agreement that it customarily engages for its other similar research activities except that under no circumstance can such Permitted Subcontractor be debarred or disqualified by a regulatory authority. Furthermore, notwithstanding the foregoing, Dicerna 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 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 of any and all Product-specific or Compound-specific inventions developed by such Permitted Subcontractor to the extent relating to Compound or Product in the course of performing such subcontracted work in Dicerna; (iii) that does not under any circumstance impose any payment obligations or liability on Lilly, and (iv) that is otherwise consistent with the terms of this Agreement. Dicerna shall remain directly responsible for all of its obligations under this Agreement that have been delegated, subcontracted or sublicensed to any Permitted Subcontractor.

5. MANUFACTURING AND COMMERCIALIZATION

5.1 Compound and Product Manufacturing Generally.

5.1.1 Generally. Dicerna has the right and obligation to perform Lead Product Non-Clinical and Manufacturing Activities through IND Approval and for the initial Phase 1 Clinical Trial, subject to the terms and conditions of this Agreement and the Clinical-Phase Supply Agreement (and related quality agreement). Lilly shall be responsible for all other supply and manufacture of the Products under this Agreement. The Parties will specify in the relevant Research Plan the source of manufacture and supply of all other pre-clinical and clinical Products.

5.1.2 Manufacturing Standards. Without limiting the foregoing, but subject to the terms and conditions of this Agreement and the Clinical-Phase Supply Agreement, Lilly has the sole decision authority related to Product supply. Dicerna will manufacture the Lead Product under GMP; provided, however, that if Dicerna uses a contract manufacturer or other subcontracted element of the supply chain, Lilly will have the right to audit and approve (or reject) such contract manufacturer in advance, provided that such approval shall not be unreasonably withheld, delayed or conditioned. The Parties agree that the manufacturer shall be listed in the Research Plan as determined by the JSC.

5.1.3 Visits to Facilities. Lilly may conduct ongoing and routine audits of Dicerna or its subcontractors in accordance with Section 4.7.2 to ensure compliance with applicable GMPs during normal business hours no more than once annually and upon reasonable advance notice by Lilly 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, Lilly will have the right to conduct, or cause Dicerna to conduct, GMP 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. All such audits shall be done at Lilly's cost and expense.

5.1.4 Notice of Inspections. If legally permissible, Dicerna shall provide notice to Lilly 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 Lilly with the results of any such review, audit or inspection. Lilly shall be given the opportunity to provide assistance to Dicerna in responding to any such review, audit or inspection.

5.2 Product Quality Generally. The relevant 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. Lilly will, subject to the Clinical-Phase Supply Agreement and related quality agreements, determine in accordance with applicable regulatory requirements such Product quality standards that must be included in any manufacturing requirements for Product and Lilly will in all circumstances have the sole right to make the final release determinations for the Products, as the Parties shall set forth in greater detail in the applicable quality agreement.

5.3 Manufacturing and Quality Agreements.

5.3.1 Clinical-Phase Supply Agreement. The Parties shall negotiate in good faith and enter into a supply agreement ("**Clinical-Phase Supply Agreement**"), and related quality agreement, within [***] prior to the date on which the JSC determines the delivery of GLP toxicology materials shall occur, or as otherwise mutually agreed by the Parties in writing, covering the supply of the Lead Product through IND Approval, including, if applicable, Dicerna's provision of clinical trial materials, and subject to Lilly's audit of Dicerna and its supply chain. Under the Clinical-Phase Supply Agreement, Lilly shall be responsible for covering the costs for the manufacture of the Products at Dicerna's fully loaded costs, except that Dicerna shall be responsible to cover the costs for the manufacture of the Lead Product through the initial Phase 1 Clinical Trial.

5.3.2 Quality Agreements. Any quality agreement entered in connection with the Clinical-Phase Supply Agreement shall set forth the quality expectations, responsibilities, rights (including, as applicable and agreed upon, audit requirements) and requirements relating to the manufacture and supply of the Products, including allocations of responsibility for quality elements and provisions addressing sub-contractors and suppliers, change control and corresponding regulatory amendments, out-of-specification results, deviations and investigations, Product recalls, withdrawals, product complaints and a list of key quality contacts.

5.4 Commercialization by Lilly. Lilly shall have the sole right and be responsible for Commercialization of the Products, and shall use Commercially Reasonable Efforts to achieve a First Commercial Sale of one Product in the United States. Upon Lilly launching at least one Product in the United States, Lilly's obligation to use Commercially Reasonable Efforts to Commercialize Products would cease.

6. GOVERNANCE AND JOINT STEERING COMMITTEE

6.1 Project Leader. Within [***] of the Effective Date, Lilly and Dicerna shall [***] to serve as the primary point of contact between the Parties with respect to each Target being prosecuted under the Research Program (each, a "**Project Leader**"). The Project Leaders shall regularly communicate with each other to address Research Program-related issues, needs and updates and facilitate communications and organization of Working Groups associated with each active Research 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 dispute resolution mechanism set forth in Section 19.6, the Project Leaders shall attempt, for a period of [***], to resolve such Dispute.

6.2 Alliance Manager. Within [***] of the Effective Date, each Party shall also appoint an individual to act as the Alliance Manager for such Party (each, an "**Alliance Manager**"). Each Alliance Manager shall thereafter be permitted to attend meetings of the JSC and any sub-committee as a nonvoting observer. The Alliance Managers 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 shall help facilitate all such activities hereunder. For avoidance of doubt, the individual appointed by a Party to act as an Alliance Manager may, but need not, be the same individual appointed by such Party as a Project Leader.

6.3 Working Groups. The Parties shall establish working groups (each, a "**Working Group**") to oversee the activities of each Research 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 regarding (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 three (3) additional Working Groups to oversee, respectively, (i) technology transfer pursuant to Section 7.4, (ii) the manufacturing supply chain for the Products, and (iii) the strategy for prosecution and maintenance of Joint Inventions.

6.4 Joint Steering Committee.

6.4.1 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 Research Program. The JSC shall be comprised of

[***] from Lilly and [***] from Dicerna. 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 Research Program. One (1) of the members 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. The JSC shall be promptly disbanded upon completion of the Research Program.

6.4.2 JSC Meetings. The JSC shall meet in accordance with a schedule established by mutual written agreement of the Parties, and no less frequently than once every Calendar Quarter until expiration of the Research Collaboration Term. 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. Lilly 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 Lilly that s/he does not approve of the minutes, the minutes shall be deemed to have been approved by such member.

6.4.3 JSC Functions. The JSC's responsibilities with respect to the Research Program are as follows:

(a) Overseeing and coordinating the activities of the Parties under the Research Program;

(b) Establishing acceptable murine pharmacologic activity for Non-Hepatocyte Targets;

(c) Facilitating the exchange of Know-How and materials as required hereunder;

(d) Periodically reviewing the progress of the Research Program; and

(e) Suggesting an update or modification of each Research Plan. 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 corresponding update of the Project Funding and any other potential implications, such as delays or other effects of such modification or update.

6.4.4 JSC Disputes; Authority. The JSC will endeavor to make decisions by consensus, with each of Lilly and Dicerna having one vote. 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 Lilly and Dicerna with appropriate decision making authority. In the event the designated officers are unable to resolve the issue within thirty (30) days, then: [***]

6.4.5 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.

7. LICENSES

7.1 License Grant to Lilly. Subject to the terms and conditions of this Agreement, each of Dicerna US and Dicerna Cayman hereby grants to Lilly: (a) an exclusive (even as to Dicerna US and Dicerna Cayman), royalty bearing, sub-licensable (through multiple tiers) (subject to Section 7.2), worldwide, license under the Licensed Technology to Research, 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 Lilly's obligations under the Research Program, including Research and Development work required to select Targets and related Compounds and Products for purposes of this Agreement.

7.2 Sublicenses. Subject to the terms and conditions of this Agreement, Lilly shall have the right to sublicense: (a) any and all rights licensed to Lilly under Section 7.1 to its Affiliates; and (b) any and all rights licensed to Lilly under Section 7.1 to any Third Party.

7.3 License Grants to Dicerna. Lilly hereby grants to Dicerna during the Term a non-exclusive, non-royalty bearing, fully paid-up, non-sub-licensable (except to Affiliates and Third Party subcontractors of Dicerna solely as needed to perform services for Dicerna under this Agreement), worldwide license under Lilly Intellectual Property, solely to the extent necessary for Dicerna to perform its duties and obligations according to the Research Program.

7.4 Know-How Transfer; Availability of Employees. Within [***] following Lilly's assumption of responsibility for Development or Commercialization of a Product under Article 4 or the Clinical-Phase Supply Agreement (and from time to time during the Term if new Know-How comes to be Controlled by Dicerna US or Dicerna Cayman), or Lilly's termination of this Agreement under Section 14.3 followed by an election to retain license rights hereunder, Dicerna shall disclose and/or deliver to Lilly, to the extent not previously provided, copies of all data and information in Dicerna US's or Dicerna Cayman's possession relating to the Licensed Know-How which is reasonably necessary for Lilly's Development or Commercialization of such Product (including for regulatory purposes). Upon Lilly's reasonable request, Dicerna will: (a) provide reasonable technical assistance to Lilly during such disclosure or delivery set forth in the preceding sentence; and (b) make its employees and non-employee consultants reasonably available at their respective places of employment to consult with Lilly on issues arising in the course of Lilly's Research, Development 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 a Working Group established for such purposes, which Working Group may put in place a technology transfer plan expressly identifying Know-How owned or Controlled by Dicerna US or Dicerna Cayman to be transferred and the timing for such transfer.

7.5 Covenants. Each of Dicerna US and Dicerna Cayman 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 Lilly's exercise of its license rights to such Licensed Technology, or (ii) adversely affects the license rights granted to Lilly under this Agreement; or (b) assign, transfer, convey or otherwise grant to any Person any rights to any Licensed Technology, New Platform Patents, Joint Know-How or Joint Patent Rights or any Compounds or Products, in any manner that conflicts with the exclusive licenses granted to Lilly pursuant to Section 7.1.

7.6 Freedom to Operate. Subject to and without limiting any other license rights or exclusivity granted to Lilly under this Agreement, Lilly (and its Affiliates) and Dicerna (and its Affiliates) will also have the right to use any Confidential Information disclosed by the other Party in connection with the Research 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 Licensed Patent Rights. An individual's memory will be considered to be unaided if [***]

7.7 No Implied Licenses. Except as expressly set forth in this Agreement, neither Lilly, on the one hand, or Dicerna US or Dicerna Cayman, 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 US and Dicerna Cayman, Lilly is not forfeiting any rights that Lilly 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 License Agreements.

7.8.1 If, after the Effective Date, Dicerna US or Dicerna Cayman enters into any license agreement with a Third Party and Controls Patent Rights or Know-How under such license agreement that would be necessary or reasonably useful for developing a New Platform for Non-Hepatocyte Cardiometabolic Targets or a New Platform for Non-Hepatocyte Neurodegeneration/Pain Targets, then Dicerna shall so notify Lilly and the rights and licenses granted to Lilly under this Agreement with respect to such Third Party agreement shall be subject to Lilly (a) agreeing to be bound by the terms of any such Third Party agreement applicable to a sublicensee thereunder, and (b) reimbursing Dicerna US or Dicerna Cayman for any amounts that become owing to such Third Party by reason of the grant to, or exercise by or under the authority of, Lilly of such rights; provided, that, any amounts owing to such Third Party cannot be disproportionately allocated to the Selected Targets, Products or Lilly's rights hereunder (*e.g.*, the royalty for Product sales cannot be greater than the royalty due for any other product under the agreement). Upon request by Lilly, Dicerna shall disclose to Lilly a true and correct written description of the payment and other relevant obligations, and Lilly's obligation to reimburse such amounts following such request shall be limited to those payment obligations as so disclosed by Dicerna. In the event Lilly does not agree in writing to reimburse Dicerna for such amounts upon request, and 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.

7.8.2 If, after the Effective Date, Dicerna identifies Patent Rights or Know-How covering or relating to RNAi or oligonucleotide platform technologies owned or Controlled by a Third Party that would be necessary or reasonably useful for targeting mechanisms that bind to or are intended to bind to and induce an inhibition, disruption or modulation of mRNA in Hepatocyte Cardiometabolic Targets or Non-Hepatocyte Targets, then Dicerna shall so notify Lilly and the Parties shall coordinate in good faith the negotiation of one (1) or more agreements in order to facilitate Lilly having access to such technology, which may be through an agreement directly between Lilly and such Third Party.

8. FINANCIAL PROVISIONS

8.1 Upfront Payments.

8.1.1 In consideration for the rights granted to Lilly pursuant to this Agreement, Lilly shall pay to Dicerna a one-time, non-refundable, non-creditable upfront payment of one hundred million Dollars (USD $100,000,000) by no later than thirty (30) days following the Effective Date (the "**Upfront Cash Payment**").

8.1.2 As of the date of execution of this Agreement, the Parties have entered into a Share Issuance Agreement, pursuant to which Lilly will purchase one hundred million Dollars (USD $100,000,000) of Dicerna US's Common Stock at a twenty-five percent (25%)

premium to Dicerna US's volume weighted average stock price for the thirty (30) day period ending on the last trading day before the date of execution of this Agreement.

8.2 Development Milestones.

8.2.1 On a Selected Target-by-Selected Target basis, within [***] after the first Product hereunder Directed To a Selected Target that is a Non-Hepatocyte Target achieves Proof of Principle, Lilly shall pay Dicerna US Five Million US Dollars (USD $5,000,000), which shall be non-refundable and non-creditable. Such payment shall not be due for any such Products Directed To a Selected Target after the first Product Directed To that Selected Target achieves Proof of Principle nor, for avoidance of doubt, will it be due for any Selected Target that becomes a Discontinued Target prior to the payment of such amounts.

8.2.2 On a Product-by-Product basis, within [***] after first achievement of each milestone set forth in the table below by Lilly, its Affiliate or its sublicensee of Lilly's rights in the Product (each, a "**Development Milestone Event**"), Lilly shall notify Dicerna US and make the corresponding milestone payment to Dicerna US (each, a "**Development Milestone Payment**"). Such payment shall be non-refundable and non-creditable and [***]

	Development Milestone Events	Milestone Payments
1.	[***]	**USD** [***]
2.	[***]	**USD** [***]
3.	[***]	**USD** [***]
4.	[***]	**USD** [***]
5.	[***]	**USD** [***]
	Total Possible Development Milestone Payments per Product	**USD** [***]

8.3 Commercialization Milestones. On a Product-by-Product basis, within [***] after the end of the Calendar Quarter in which each milestone event set forth in the table below is first achieved by Lilly, its Affiliate or its sublicensee (unless Dicerna or its Affiliate is the sublicensee) of Lilly's rights in the Product (each, a "**Commercial Milestone Event**"), Lilly shall notify Dicerna US and make the corresponding, non-refundable, non-creditable milestone payment to Dicerna US (each, a "**Commercial Milestone Payment**"):

	Commercial Milestone Events	Commercial Milestone Payments
1.	First time Annual Net Sales of the Product exceed [***] Dollars (USD [***])	**USD** [***]
2.	First time Annual Net Sales of a Product exceed [***] Dollars (USD [***])	**USD** [***]
4.	First time Annual Net Sales of a Product exceed [***] Dollars (USD [***])	**USD** [***]
	Total Possible Commercial Milestone Payments per Product	**USD** [***]

8.4 Royalties.

8.4.1 Royalty Payments – Hepatocyte Cardiometabolic Targets. During the Royalty Term for each Product, Lilly shall pay Dicerna US a royalty on only that portion of Net Sales of a Product Directed to a Hepatocyte Cardiometabolic Target as designated below and at the rates set forth below (each such royalty payment, a "**Hepatocyte Royalty**"):

Annual Worldwide Net Sales on a Product-by-Product basis	Royalty Rate
USD $0 up to USD $[***]	[***]
From USD [***] up to USD [***]	[***]
From USD [***] up to USD [***]	[***]
From USD [***] up to USD [***]	[***]
From USD [***] and up	[***]

8.4.2 Royalty Payments – Non-Hepatocyte Targets. During the Royalty Term for each Product, Lilly shall pay Dicerna US a royalty on only that portion of Net Sales of a Product Directed To a Non-Hepatocyte Target as designated below and at the rates set forth below (each such royalty payment, a "**Non-Hepatocyte Royalty**", and together with the Hepatocyte Royalty, a "**Royalty**"):

Annual Worldwide Net Sales on a Product-by-Product basis	Royalty Rate
From USD $0 up to USD [***]	[***]
From USD [***] up to USD [***]	[***]
From USD [***] up to USD [***]	[***]
From USD [***] and up	[***]

8.4.3 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 an Effective Patent Claim in such country; (b) expiration of all data or regulatory exclusivity

periods for such Product in such country; and (c) [***] after the First Commercial Sale of such Product in such country (the "**Royalty Term**"), in each case subject to Section 8.4.4.

8.4.4 Royalty Step-Downs. The Royalties under Section 8.4.1 and Section 8.4.2 shall be reduced by the following step-down provisions:

(a) **No Effective Patent Claim**. Notwithstanding Section 8.4.1 and Section 8.4.2, 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 rate at which Lilly is required to pay during the Royalty Term to Dicerna US on the Net Sales of such Product in such country shall be reduced to [***] of the Royalty rate set forth in Section 8.4.1 or Section 8.4.2, as applicable for the rest of the Royalty Term.

(b) **Third Party Royalties – Anti-Stacking**. If Lilly determines that Lilly and/or its Affiliates or sublicensees need to obtain a license from a Third Party (including an Acquirer) in order to Research, Develop or Commercialize a Product in a particular country, Lilly shall have the right to deduct [***] percent [***] of all upfront, milestone, royalty or other payments due from Lilly and/or its Affiliates or sublicensees under such license with the Third Party from the Royalty owing to Dicerna US during the applicable period for the such Product under Section 8.4.1 and Section 8.4.2, as applicable, subject to the Royalty reduction floor as set forth in Section 8.4.4(e); provided, that any credit not applied because of such Royalty reduction floor may be carried forward to future Calendar Quarters.

(c) **Competing Products – Initial Reduction**. On a country-by-country and Product-by-Product basis, Lilly's obligation to pay Royalties to Dicerna US for a particular Product in a country shall be reduced to [***] percent [***] of the Royalty rate set forth in Section 8.4.1 and Section 8.4.2, as applicable, upon the first sale of Competing Product(s) of such Product by a Third Party or Third Parties in such country. A "**Competing Product**" of a Product means a product whose sale is not authorized by Lilly or its Affiliates or sublicensees, that is [***].

(d) **Competing Products – Royalty Elimination**. On a country-by-country and Product-by-Product basis, Lilly's obligation to pay Royalties to Dicerna US for a particular Product in a country under Section 8.4.1 or Section 8.4.2, as applicable, shall expire and be of no further effect from and after the first Calendar Quarter in which a Competing Product to the Product has a market share of [***] percent [***] or more in a given country (measured in local currency, over the Calendar Quarter, as reported by [***], at which point the Royalty Term for that Product shall also be considered terminated in that country.

(e) **Limit on Royalty Reductions**. In no event shall the Royalties owed under Sections 8.4.1 or Section 8.4.2, as applicable, with respect to a Product in a country be reduced by operation of Sections 8.4.4(a), 8.4.4(b) or 8.4.4(c) by

more than an aggregate of [***] percent [***] of what would otherwise be owed under the tables set forth in Sections 8.4.1 or Section 8.4.2, as applicable with respect to such Product in such country, it being understood that this restriction will not apply to Section 8.4.4(d).

9. REPORTS AND PAYMENT TERMS

9.1 **Net Sales Reports and Royalties Due**. During the Royalty Term, Lilly shall furnish to Dicerna US a written report for each Calendar Quarter showing the global Net Sales by Product sold by Lilly, its Affiliate or sublicensee during the reporting Calendar Quarter, the Royalties payable under this Agreement and whether a Commercial Milestone Event has been achieved in sufficient detail to allow Dicerna US to verify the amount of Royalties or Commercial Milestone Payments paid by Lilly 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.

9.2 [***].

9.3 **Payment Currency / Exchange Rate**. All payments to be made by Lilly to Dicerna US under this Agreement shall be made in USD. Payments to Dicerna US shall be made by electronic wire transfer of immediately available funds to the account of Dicerna US, as designated in writing to Lilly. If any currency conversion is required in connection with the calculation of amounts payable hereunder, such conversion shall be [***]

9.4 **Taxes**. Each Party shall be responsible for its own tax liabilities arising under this Agreement. Subject to this Section 9.4, Dicerna US shall be liable for all income and other taxes (including interest) ("**Taxes**") imposed upon any payments made by Lilly to Dicerna US under this Agreement ("**Agreement Payments**"). 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 Lilly's assignment of this Agreement to an entity outside the United States leads to the imposition of withholding Tax liability on Dicerna US 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, Lilly will indemnify and hold harmless Dicerna US from any such additional or increased withholding Tax liability (except to the extent that Dicerna US or any of its Affiliates can reclaim it, provided that Dicerna US will be reimbursed for any reasonable out of pocket costs incurred in the reclaim). 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 such payments of Taxes. 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 fifteen (15) Business Days) prior to making such payment, and the Parties shall cooperate and exercise their reasonable best efforts to ensure that any such withholding Taxes are reduced as far as possible under the provisions of any Applicable Law, and shall provide Payee reasonable assistance in order to allow Payee to obtain the benefit of any present or future treaty against double taxation or refund or reduction in Taxes which may apply to the Agreement Payments.

9.5 Audit Rights (Financial).

9.5.1 Each Party (the "**Auditing Party**") shall have the right to appoint at its expense an independent certified public accountant of nationally recognized standing (the "**Accounting Firm**") reasonably acceptable to the other Party to inspect or audit the relevant records of the other Party (the "**Audited Party**") in order to verify that the amount of such expenses and payments ("**Expenses and Payments**") were correctly determined. Prior to commencing the implementation of such audit the Auditing Party shall submit an audit plan, including audit scope, to the other Audited Party for approval, which shall not be unreasonably withheld. The Audited Party shall each make its records available for inspection or audit by the Accounting Firm during regular business hours at such place or places where such records are customarily kept, upon reasonable notice from the Auditing Party, solely to verify the expenses and payments hereunder were correctly determined. Such inspection or audit right shall not be exercised by the Auditing Party more than once in any Calendar Year and may cover a period [***] All records made available for inspection or audit shall be deemed to be Confidential Information of the Audited Party. The results of each inspection or audit, if any, shall be binding on both Parties. The Auditing Party shall bear the full cost of such audit unless such audit discloses at least a [***] shortfall [***], in which case the Audited Party will bear all reasonable costs and expenses of the audit. The Auditing Party will be entitled to recover any shortfall in payments as determined by such audit. Similarly, if the audit reveals an overpayment, the Auditing Party will be entitled to recover such overpayment as determined by such audit as actually received by the Audited Party. Any underpayment or overpayment as determined under this Section 9.5.1 shall be promptly (but in any event no later than [***] after the Auditing Party's receipt of the Accounting Firm's report so concluding) paid to the Party entitled to payment hereunder.

9.5.2 [***].

10. INTELLECTUAL PROPERTY RIGHTS

10.1 Disclosure of Inventions. [***]

10.2 Lilly Background IP. As between the Parties, Lilly shall own and Control all right, title and interest in and to all Patent Rights or Know-How owned or Controlled by Lilly and existing as of or before the Effective Date, or generated or acquired outside the scope of the Research Program and this Agreement, and shall own any Improvements to any of the foregoing, regardless of whether such Improvements are made by or on behalf of Lilly or Dicerna (or an Affiliate of Lilly or Dicerna, as applicable) ("**Lilly Background IP**"). Dicerna hereby assigns and agrees to assign to Lilly all

right, title and interest in and to any such Improvements within the Lilly Background IP that are discovered, conceived or otherwise generated by Dicerna in connection with the Research Program or otherwise.

10.3 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 owned or Controlled by Dicerna and existing as of or before the Effective Date (including any Patent Rights and Know-How Controlled by Dicerna directed to the GalXC Platform), or generated or acquired outside the scope of the Research Program and this Agreement, and shall own any Improvements to any of the foregoing, regardless of whether such Improvements are made by Dicerna or Lilly ("**Dicerna Background IP**"). Lilly hereby assigns and agrees to assign to Dicerna all right, title and interest in and to any such Improvements within the Dicerna Background IP that are discovered, conceived or otherwise generated by Lilly in connection with the Research Program or otherwise. If the Parties determine by mutual agreement that any Lilly 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 Lilly Know-How through a joint patent process via a Working Group pursuant to Section 6.3, prior to contributing such Lilly Know-How to the GalXC Platform.

10.4 Joint Inventions.

10.4.1 [***].

10.4.2 Exploitation. [***]

10.4.3 Assignment and Transfer of Interests in Joint Inventions. [***]

10.5 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 Inventions made or conceived by such employee(s), contractor(s) or other agent(s) in connection with this Agreement.

10.6 Filing, Prosecution, Enforcement and Defense.

10.6.1 GalXC Patents and Dicerna Background IP. As between the Parties, Dicerna shall, at its sole cost, be responsible for the filing, prosecution, enforcement and defense of any Licensed Patent Rights directed to the GalXC Platform ("**GalXC Patents**") and Dicerna Background IP, other than any Product-Specific Patents; provided, that Lilly shall have the first right, but not the obligation, at its sole cost, to enforce the GalXC Patents to the extent such enforcement action is solely directed against an RNAi product Directed To a Selected Target being Researched, Developed, used, made (including formulated) or Commercialized by a Third Party ("**Competing RNAi Product**").

10.6.2 New Platform Patents and Other Joint Patent Rights. The Parties will share, in equal amount, the out-of-pocket expenses incurred in connection with such preparation, filing, prosecution and maintenance of the Licensed Patent Rights directed to

a New Nucleic Acid Platform ("**New Platform Patents**") and other Joint Patent Rights (other than Product-Specific Patents) through a joint patent process via a Working Group pursuant to Section 6.3, and using a mutually agreed counsel (which may be in-house counsel), and shall equally share the costs of such filing and prosecution activities, unless a Party opts to abandon its interest in a Joint Patent Right by notice to the other Party, in which case Section 10.6.4 shall apply. Each Party shall reimburse the other for its share of such expenses following receipt of an invoice from the Party incurring such expenses (including reasonable documentation of such expenses if requested). Each Party shall keep the other reasonably informed of, and consult with the other Party with respect to the status and prosecution of all patent applications and patents included in such Joint Patent Rights, including providing in a timely manner the other Party with copies of all material correspondence with the applicable patent regulatory authority and the opportunity to review and comment on any papers, responses or other filings prepared for submissions to said authorities in advance of their filing. Each Party at its own discretion shall have the opportunity to separately enforce and defend the New Platform Patents and other Joint Patent Rights following good faith consultation with the other Party, keeping the other Party regularly informed throughout the proceeding and considering in good faith such other Party's comments (other than Product-Specific Patents, which shall be subject to Section 10.6.3) except that: (i) Lilly shall have the first right but not the obligation to enforce the New Platform Patents and Joint Patent Rights (other than Product-Specific Patents), at Lilly's cost, to the extent such action is solely directed against a Competing RNAi Product; and (ii) Dicerna shall have the first right but not the obligation to enforce the New Platform Patents and Joint Patent Rights (other than Product-Specific Patents), at Dicerna's cost, to the extent such enforcement action is solely directed to a product competitive to a product being Researched, Developed or Commercialized by Dicerna or its licensees.

10.6.3 Product-Specific Patents. Lilly shall be responsible for the prosecution, maintenance, defense, and enforcement of all Joint Patent Rights and Licensed Patent Rights directed to the Product or Selected Target ("**Product-Specific Patents**"), at Lilly's cost.

10.6.4 Abandonment of Patent Rights. If Dicerna or Lilly elects to cease the filing, prosecution, maintenance and/or defense of a Patent Right for which Dicerna or Lilly, as applicable, is in control of the filing, prosecution, maintenance and/or defense pursuant to Section 10.6.2 or 10.6.3 in any country of the Territory, Dicerna or Lilly, as applicable, shall provide the other Party with notice promptly following its decision to abandon the filing, prosecution, maintenance and/or defense of such Patent Right, but in no event later than sixty (60) days 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 such 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 such 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 non-abandoning Party shall timely inform the abandoning Party if it too decides to finally abandon the respective Patent Right, in which event the other 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 10.6.4. Notwithstanding the foregoing, (a) if Lilly determines, in its reasonable discretion following good faith discussions with Dicerna, that any such abandonment is necessary to avoid detrimental effect to any Product-Specific Patent, then Dicerna shall have no right pursuant to this Section 10.6.4 to elect to take over and continue the filing, prosecution, maintenance or defense of such Product-Specific Patent.

10.6.5 Notification of Infringement. Lilly 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 Joint Patent Rights shall be done in accordance with this Section 10.6.

10.6.6 Control of Enforcement Actions. The Party specified in this Section 10.6 as having control over enforcement of particular Patent Rights alleged or threatened to be infringed in an Action (the "**Initial Party**") may, at its expense, 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 Lilly Intellectual Property or Licensed Technology is invalid or unenforceable or which adversely affects the scope of any of the Lilly Intellectual Property (in case where Dicerna is the Initial Party) or Licensed Technology (in case where Lilly 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 costs 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 thirty (30) Business Days following the date on which Lilly or Dicerna (as applicable) notifies the other Party of any alleged or threatened infringement of the Licensed Patent Rights, New Platform Patents or Joint Patent Rights of which they become aware pursuant to Section 10.6.5, the other Party may do so, at the other Party's expense; provided, however, that in the event the initial Party in good faith objects to the other Party pursuing such Action on the grounds that pursuit of such Action is not in the long term best interest of the Products, the GalXC

Platform or the New Nucleic Acid Platforms, the matter shall be presented to the JSC for discussion pursuant to Section 6.4.4, and the other Party shall not initiate such Action until review by the JSC is complete in accordance with Section 6.4.4. 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 deemed to be Net Sales of a Product directed to a Non-Hepatocyte Target or in the case of any product with a Neurodegeneration or Pain Indication, or Net Sales of a Product directed to a Hepatocyte Cardiometabolic Target, in case of any other accused product, in each case for purposes of Royalties due hereunder, but for no other purposes.

10.6.7 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 New Platform Patents, Joint Patent Rights and Product-Specific Patent Rights, in each country and region where it is possible to do so. Lilly will elect whether to pursue patent term extensions or supplemental protection certificates for Product-Specific Patent Rights and Dicerna agrees to abide by such election. Dicerna shall provide prompt and reasonable assistance, as requested by Lilly, at Lilly'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.

10.7 Management of Background Patents. Lilly shall have sole responsibility for and control over the filing, prosecution, maintenance and enforcement of the Lilly Patents (other than the Joint Patent Rights and New Platform Patents), at Lilly's sole expense.

10.8 Product Infringement. [***]

10.9 Product Trademarks. Lilly 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 Lilly any right to use any trademark Controlled by Dicerna and/or its Affiliates. Subject to the foregoing, Lilly 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, Lilly shall recognize Dicerna in a press release associated with the Regulatory Approval of any Product.

11. CONFIDENTIALITY

11.1 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 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 consistent with the confidentiality provisions of this Agreement as they apply to the recipient Party.

11.2 Exceptions. The obligations under this Article 11 shall not apply to any information to the extent the recipient Party can demonstrate by competent evidence that such information:

11.2.1 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;

11.2.2 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;

11.2.3 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

11.2.4 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.

11.3 Authorized Disclosures. Subject to this Section 11.3, the recipient Party may disclose Confidential Information (including the Agreement) belonging to the other Party:

11.3.1 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 consistent with the confidentiality provisions of this Agreement as they apply to the recipient Party.

11.3.2 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.

11.3.3 to governmental or other regulatory agencies by (a) Lilly or a Lilly 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.

11.3.4 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.

11.3.5 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 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.

11.3.6 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.

11.4 Regulatory Approvals. The Parties expressly agree that Lilly may submit Confidential Information of Dicerna to any Regulatory Authority to the extent necessary for obtaining Regulatory Approvals for Products in the Field. The Parties expressly agree that Dicerna may submit Confidential Information of Lilly to any Regulatory Authority to the extent necessary for obtaining Regulatory Approvals for Returned Compounds and Products in the Field.

11.5 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 [***] Business Days 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 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.

12. PUBLICATIONS AND PUBLICITY

12.1 Publications. Notwithstanding anything to the contrary in this Agreement, Lilly shall have the right to publish the results of the Research 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 [***] Business Days prior to its submission for publication. Dicerna will use diligent efforts to complete its review at least [***] Business Days prior to the intended publication date. Lilly 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 [***] Business Days in order to allow the appropriate Party to pursue patent protection.

12.2 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 Research 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 8.2 or Section 8.3, to the extent reasonably practicable, Dicerna will

provide Lilly with no less than [***] Business Days in which to review and approve such announcement, such approval not to be unreasonably withheld, conditioned or delayed.

13. HSR FILINGS AND CLOSING

13.1 **HSR Filings**. If required by Applicable Laws, 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 Lilly will pay the filing fees incurred by both Parties in connection with the filings required pursuant to the HSR Act. In the event the Parties determine that HSR filings are required, the Effective Date shall not be deemed to have occurred and this Agreement (other than this Article 13) shall not be binding 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 [***] days after the Parties make their respective HSR filings.

13.2 **Conduct Pending HSR Clearance Date**. If the Parties determine that HSR filings are required, 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.

14. TERM AND TERMINATION

14.1 **Term**. Subject to Article 13, the term of this Agreement (the "**Term**") will commence on the Effective Date and (subject to earlier termination in accordance with Section 14.2 or Section 14.3) will expire on a Product-by-Product basis upon the expiration of the Royalty Term for such Product. Upon expiration of this Agreement (but not termination), the licenses granted to Lilly under this Agreement shall become royalty-free, fully paid-up, perpetual and irrevocable licenses.

14.2 **Voluntary Termination by Lilly**. Lilly has the right to terminate the Agreement in its entirety or on a Selected Target-by-Selected Target, Compound-by-Compound or Product-by Product basis, without cause and in its sole discretion upon ninety (90) days' prior written notice to Dicerna.

14.3 **Termination for Cause**.

14.3.1 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 if such breach is not cured. If the material breach is not cured by the allegedly breaching Party within [***] days (or ninety [***] days 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 [***] day 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 [***] day 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 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 [***] days 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 [***] days after the arbitration award determining that the conditions for termination of this Section 14.3 are met; provided further that the breach is not cured within such [***] day 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.

14.3.2 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 Lilly-owned patent claim, Lilly shall be entitled to terminate this Agreement with immediate effect upon written notice to Dicerna US with respect to the challenged Product-

Specific Patent and such Patent Right shall no longer be a royalty-bearing Product-Specific Patent.

14.3.3 In the event that Lilly 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, Dicerna US shall be entitled to terminate this Agreement with immediate effect upon written notice to Lilly with respect to the challenged Licensed Patent Right and such Patent Right shall not longer be a Licensed Patent Right.

15. EFFECTS OF TERMINATION

15.1 Termination of Agreement.

15.1.1 If this Agreement terminates for any reason other than expiration, then no later than [***] days after the effective date of such termination, Lilly shall pay all amounts then due and owing (except that Lilly shall have the right to offset any undisputed monies owed to Lilly 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, all Confidential Information received from the other Party and all copies thereof; provided, however, that each Party may keep one (1) copy of Confidential Information received from the other Party 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 freedom to operate rights granted to either Party under Section 7.6 which shall survive) of the Parties hereunder shall terminate as of the date of such termination.

15.1.2 Notwithstanding anything to the contrary under this Agreement, Lilly shall have the right. in lieu of exercising its right to terminate this Agreement under Section 14.3, to instead, by way of written notice to Dicerna, to continue this Agreement in accordance with its terms subject to reducing all payments due from Lilly to Dicerna US following the date of termination pursuant to Section 8.2, Section 8.3 and Section 8.4 by [***] percent [***] For clarity, in the case that a particular election is not a termination of the Agreement in its entirety but instead on a Selected Target-by-Selected Target, Compound-by-Compound or Product-by-Product or basis, then such foregoing terms will only apply to the Compounds, Product(s) and/or Selected Target(s) that could have been terminated.

15.2 Target/Product Return.

15.2.1 Upon any Selected Target becoming a Discontinued Target, voluntary termination of this Agreement in its entirety or with respect to particular Compounds, Products or Selected Targets by Lilly under Section 14.2, or termination of this Agreement for cause by Dicerna under Section 14.3, any license rights granted by Dicerna US and/or

Dicerna Cayman to Lilly to the Discontinued Target or affected Products, as applicable, (or rights to all Reserved Targets and Selected Targets in the event of the termination of this Agreement as a whole) shall cease and revert to Dicerna subject, however, in the event a partial termination, to the exclusivity terms set forth in Sections 3.3, 3.4 and 3.6. For purposes of this Section 15.2, "**Returned Compounds and Products**" shall mean the following: (a) in the case of a Reserved Target or Selected Target becoming a Discontinued Target, all Product(s) (or products, if no Compound was selected) and Compound(s) then being Researched and Developed under this Agreement that are Directed To the Discontinued Target(s), but not other Products and Compounds; (b) in the case of voluntary termination by Lilly on a Compound-by-Compound or Product-by-Product basis, the Product(s) and Compound(s) that are the subject of the termination, but not other Products and Compounds; and (c) in the case of voluntary termination by Lilly in its entirety, or by Dicerna US or Dicerna Cayman for cause, all Products and Compounds then being Researched, Developed or Commercialized under this Agreement. 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 Reserved Target or a Selected Target, (b) the licenses herein shall be deemed to have never granted and (c) neither Party shall have been subject to any exclusivity obligations.

15.2.2 Lilly shall, at Dicerna's request, transfer to Dicerna the following items with respect to Returned Compounds and Products, to the extent necessary or reasonably useful 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 Lilly or its Affiliates; all data and results arising from Lilly'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 marketing reports, reimbursement studies and promotional materials solely related to the Compounds and Products that are transferable by Lilly or its Affiliates to Dicerna; provided, however, that Lilly shall have the right to retain copies of the foregoing information and documentation.

15.2.3 [***] license [***]of the Returned Compounds and Products [***] The Parties will agree in good faith regarding a technology transfer plan to facilitate Dicerna US's and/or Dicerna Cayman's practice of the foregoing license, which plan will provide for reasonable reimbursement to Lilly for Lilly's actual costs and expenses, except that in the event Lilly terminates pursuant to Section 14.2 or Dicerna terminates pursuant to Section 14.3, the costs and expenses of such transfer shall be borne by Lilly. Any sublicense granted by Lilly 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 Lilly'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 US and Dicerna Cayman 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, Lilly shall be entitled to retain its right to payment

thereunder and shall remain liable for Royalties under Section 8.4 of this Agreement with respect to sales by such sublicensee.

15.2.4 [***]

[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]
[***]	[***]

15.2.5 For clarity, with the exception of applicable obligations under this Section 15.2 and without limiting Section 15.3 and unless expressly agreed otherwise, all obligations of the Parties with respect to the Research, Development and Commercialization of the Selected Targets, the Compounds, the Products and the New Nucleic Acid Platforms shall terminate on the date of notice of termination of this Agreement.

15.3 **Survival**. Termination or expiration of this Agreement shall not relieve Lilly, Dicerna US or Dicerna Cayman of any obligation accruing prior to such termination/expiration, nor affect in any way the survival of any other right, duty or obligation of the Lilly, Dicerna US or Dicerna Cayman 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 interpretation purposes only), Article 8 (to the extent that any amounts payable accrued prior to the effective date of such expiration/termination and remain unpaid), Article 10 (but only to the extent and with respect to intellectual property generated/developed prior to the effective date of such termination), Article 11, Article 15 and Article 17 (to the extent and with respect to claims accruing prior to the effective date of such termination) and Section 2.4 (but only with respect to information disclosed prior to the effective date of such termination), Section 8.4 (but only applicable with respect to sublicenses surviving termination (not an expiration) as described in Section 15.2.3 and further, only to the extent such sublicensee continues to Develop or Commercialize a Product that triggers such payment obligations during the Royalty Term), Section 14.1 (but only with respect to the license granted therein upon expiration), Sections 7.6, 7.7, 16.5 and 16.6 shall survive termination, and Sections 19.3 through 19.10, 19.12 through 19.21 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.

15.4 **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 Lilly, Dicerna US and/or Dicerna Cayman have expressly agreed to otherwise herein) and such termination shall not preclude Lilly, Dicerna US or Dicerna Cayman from claiming any other damages, compensation or relief that it may be entitled to upon such termination.

15.5 **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.

16. REPRESENTATIONS AND WARRANTIES

16.1 **Representations and Warranties by Each Party**. Each Party represents and warrants to the other as of the Effective Date that:

16.1.1 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;

16.1.2 Authority and Capabilities. It has (a) full corporate power and authority to execute, deliver, and perform this Agreement, and (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;

16.1.3 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);

16.1.4 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;

16.1.5 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 Research 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 Research 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.

16.2 Representations, Warranties and Covenants by Dicerna. Dicerna US and Dicerna Cayman collectively represent, warrant and, as applicable, covenant, to Lilly as follows:

16.2.1 No Targets Encumbered. As of the Effective Date, there are no Blocked Targets other than the Initial Blocked Targets.

16.2.2 No Grants that Conflict with this Agreement. Neither Dicerna US nor Dicerna Cayman, nor their Affiliates has granted, nor will Dicerna US or Dicerna Cayman or their 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 Lilly hereunder. Dicerna US and Dicerna Cayman collectively have Control over all Know-How and Patent Rights owned by them or their Affiliates as of the Effective 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 Effective Date. Dicerna US and Dicerna Cayman shall ensure that: (a) all Know-How relating to, and Patent Rights directed to, (i) the GalXC Platform and New RNAi Platform or (ii) Compounds and Products Directed To Selected Targets and necessary or reasonably useful to Research, Develop, register, manufacture (including formulate), use or Commercialize 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 the BI-Dicerna Agreement, the Alexion-Dicerna Agreement or other agreements for the Blocked Targets consistent with this Section 16.2.2, are upon creation and remain thereafter Controlled by Dicerna US, Dicerna Cayman or both. Neither Dicerna US nor Dicerna Cayman, nor any of their Affiliates, will enter into any agreement after the date of execution of this Agreement conflicting with the foregoing.

16.2.3 Existing Patent Rights.

(a) All Patent Rights contained in the Licensed Technology existing as of the Effective 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 Effective 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 as may be otherwise set forth in the Blocked Target List, solely and exclusively owned or exclusively licensed to Dicerna US or Dicerna Cayman 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 Effective Date, 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 owned or Controlled by Dicerna US or Dicerna Cayman or their Affiliates as of the Effective Date that are necessary or reasonably useful to the Research, Development, manufacture (including to formulate) or Commercialization of the Compounds and Products as known to be contemplated by this Agreement as of the Effective Date. To Dicerna's knowledge, as of the Effective Date, no rights or licenses are required under any Patent Rights or Know-How for Lilly to Research, Develop, manufacture (including to formulate) or Commercialize the Products as contemplated herein as of the Effective Date other than those granted under Section 7.1.

(d) Except to the extent related to the Blocked Targets, there are no licenses or other rights granted to Third Parties regarding any Licensed Technology (or that would cause Patent Rights or Know-How to fail to be Licensed Technology by depriving Dicerna of Control) in the Field, to which Dicerna or its Affiliate is a party.

16.2.4 Litigation and Actions Relating to Intellectual Property. As of the Effective 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.

16.2.5 Other Material Claims and Actions. As of the Effective 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 Research Program or to grant the licenses or rights granted under this Agreement.

16.2.6 No Government Funding. The Inventions claimed by the Existing Patents as of the Effective 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.

16.2.7 Regulatory Documentation. With respect to the Lead Product, Dicerna and its Affiliates shall generate, prepare, maintain and retain all Regulatory Documentation that is required to be maintained or retained 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 Lead Product Directed To an Initially Named Target.

16.2.8 Ownership of Dicerna Cayman. Dicerna US and Dicerna Cayman covenant that, throughout the Term, Dicerna Cayman and Dicerna US shall remain under common Control. Dicerna US and Dicerna Cayman shall be jointly and severally liable for all obligations of "Dicerna" hereunder.

16.3 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.

16.4 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 Effective Date, will commit) an act, (ii) made (or after the Effective Date, will make) a statement or (iii) failed (or after the Effective 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.

16.5 Limitation. Neither Party nor its Affiliates makes any representation or warranty, either express or implied, that any of the Research Program, Research, Development and/or Commercialization efforts with regard to any Compound or Product will be successful.

16.6 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.

17. INDEMNIFICATION AND LIABILITY

17.1 Indemnification by Dicerna. Dicerna shall indemnify, defend and hold Lilly and its Affiliates, and their respective officers, directors, employees, contractors, agents and assigns (each, a "**Lilly Indemnified Party**"), harmless from and against losses, damages and liability, including reasonable legal expense and attorneys' fees, (collectively, " **Losses**") to which any Lilly Indemnified Party may become subject as a result of any Third Party demands, claims or actions ("**Claims**") against any Lilly Indemnified Party (including product liability claims) arising or resulting from: (a) the Research, Development, manufacture (including formulation), Commercialization or other exploitation of the 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 material breach of any term in or the covenants, warranties, representations made by Dicerna US and/or Dicerna Cayman to Lilly under this Agreement; or (d) misappropriation of a Third Party's Know-How to the extent such misappropriation arises from Lilly's, its Affiliate's or its or their sublicensees' activities hereunder from materials provided by Dicerna for the use as to which misappropriation is asserted. Dicerna is only obliged to so indemnify and hold the Lilly Indemnified Parties harmless to the extent that such Claims do not arise from the material breach of this Agreement by or the negligence or willful misconduct of a Lilly Indemnified Party.

17.2 Indemnification by Lilly. Lilly shall indemnify, defend and hold Dicerna and its Affiliates, and their respective officers, directors, employees, contractors, agents and assigns (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 pursuant to this Agreement by or on behalf of Lilly or its Affiliates (other than to the extent Dicerna or its Affiliates are carrying out work on behalf of Lilly, but subject to subclause (d)), (b) the negligence or willful misconduct of Lilly or its Affiliates pursuant to this Agreement; (c) the material breach of any term in or the covenants, warranties, representations made by Lilly to Dicerna US and/or Dicerna Cayman 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' activities hereunder from materials provided by Lilly for the use as to which misappropriation is asserted. Lilly is only obliged to so indemnify and hold the Dicerna Indemnified Parties harmless to the extent that such Claims do not arise from the material breach of this Agreement or the negligence or willful misconduct of a Dicerna Indemnified Party.

17.3 Indemnification Procedure.

17.3.1 Any Lilly 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.

17.3.2 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 [***] days 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.

17.3.3 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. 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. The Indemnified Party shall cooperate with the Indemnifying Party, at the request and expense of the Indemnifying Party, and shall be entitled to participate in the defense and handling of such Claim with its own counsel and at its own expense.

17.4 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) punitive or exemplary 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 Article 3 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. Except for liability for breach of Article 3 or Article 11, in no event shall either Party's liability hereunder exceed the amount actually received by Dicerna US under this Agreement.

17.5 Dicerna's Insurance. [***]

18. COMPLIANCE

18.1 Compliance with this Agreement. Each of the Parties shall, and shall cause their respective Affiliates to, comply in all material respects with the terms of this Agreement.

18.2 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 to fulfill its obligations under this Agreement in any material respect on such basis, the other Party shall have the right to terminate this Agreement in accordance with Section 14.3; however, under such circumstances, such termination shall be the sole remedy for such terminating Party and such terminating Party shall not be entitled to any other remedy under law or equity. All Party Specific Regulations are binding only in accordance with their terms and only upon the Party to which they relate.

18.3 Compliance with Internal Compliance Codes. 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.

18.4 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 Organisation of Economic Cooperation and Development Convention on Combating Bribery of Foreign Officials in International Business Transactions.

18.5 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 (iii) any person acting in an official capacity on behalf of any of the foregoing.

19. GENERAL PROVISIONS

19.1 Assignment. Except as provided in this Section 19.1, this Agreement may not be assigned or otherwise transferred, nor may any right or obligation hereunder be assigned or transferred, by either Party without the consent of the other Party; provided, however, that (and notwithstanding anything elsewhere in this Agreement to the contrary) either Party may, without such consent, assign this Agreement and its rights and obligations hereunder in whole or in part to an Affiliate of such Party so long as such Party remains primarily liable for any acts or omissions of such Affiliate, provided further that, either Party may, without the written consent 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 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 Sections 1.20(a)(iii) or 1.20(b)(iii)), except that Dicerna may not make any such assignment (in whole or in part) in connection with a Change of Control of Dicerna by a Lilly Competitor, in which case Section 19.2.2 shall apply. Any attempted assignment not in accordance with this Section 19.1 shall be void. Any such permitted assignee shall assume in writing all assigned obligations of its assignor under this Agreement.

19.2 Dicerna Change of Control.

19.2.1 Dicerna shall provide Lilly with [***] written notice of any Change of Control of Dicerna, which notice shall [***]

19.2.2 If Dicerna undergoes a Change of Control involving a Lilly Competitor, then:

(a) [***]

(b) [***].

19.2.3 **Acquirer with RNAi Technology**. Following any Change of Control of Dicerna to an Acquirer that Controls any Patent Rights directed to RNAi technology. Dicerna shall [***]:

19.2.4 **Acquirer Use or Incorporation of Dicerna Technology**. Following any Change of Control of Dicerna, if Dicerna's business as it relates to Dicerna's performance hereunder, the GalXC Platform or a New Nucleic Acid Platform is used or incorporated with that of the Acquirer, then Dicerna shall [***]

19.3 **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, Lilly extending the rights and immunities granted hereunder shall remain primarily liable for any acts or omissions of its Affiliates.

19.4 **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.

19.5 **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.

19.6 **Dispute Resolution**.

19.6.1 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 or JSC, if and as applicable, within [***] days 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 6.4.4 of this Agreement, either Party may refer the Dispute to senior representatives of each Party for resolution. Each Party, within [***] Business Days 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 [***] days after the Notice of Dispute, such 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 administered by the Expedited Procedures under the Rules of Arbitration of the International Chamber of Commerce ("**ICC**") pursuant to its rules in effect at the time such dispute arises, and 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.

19.6.2 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 [***] days after initiation of arbitration, the Parties shall select the arbitrator. If the Parties are unable or fail to agree upon the arbitrators within such [***] day period, the arbitrators shall be appointed by ICC. The place of arbitration shall be [***], and all proceedings and communications shall be in English.

19.6.3 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. 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 agree otherwise.

19.6.4 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 New York statute of limitations.

19.6.5 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.

19.7 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.

19.8 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.

19.9 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 Lilly, 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.

19.10 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 five (5) days 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 US or Dicerna Cayman:

Dicerna Pharmaceuticals, Inc.
87 Cambridgepark Drive

Cambridge, Massachusetts 02140

Attention: President and Chief Executive Officer

Fax: (617) 612-6298

[***]

and

Dicerna Pharmaceuticals, Inc.

87 Cambridgepark Drive

Cambridge, Massachusetts 02140

Attention: Legal Department

and

If to Lilly: Eli Lilly and Company

Lilly Corporate Center

Indianapolis, Indiana 46285

Attention: Senior Vice President, Corporate Business Development

Fax (317) 651-3051

and

Eli Lilly and Company

Lilly Corporate Center

Indianapolis, IN 46285

Attention: General Counsel

Fax (317) 433-3000

Dicerna shall also provide a copy of any notice (via e-mail if available) to Lilly's Project Leader.

19.11 Further Assurances. Lilly 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.

19.12 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.

19.13 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.

19.14 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 Non-Disclosure Agreement between Dicerna and Lilly dated March 14th, 2018.

19.15 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.

19.16 Expenses. Each Party shall pay its own costs, charges and expenses incurred in connection with the negotiation, preparation and execution of this Agreement.

19.17 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.

19.18 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.

19.19 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.

19.20 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.

19.21 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: Chief Executive Officer

DICERNA CAYMAN

By: /s/ Douglas Fambrough
Name: Douglas Fambrough
Title: Chairman

ELI LILLY AND COMPANY

By: /s/ David A. Ricks
Name: David A. Ricks
Title: Chairman & CEO

Exhibit A

Eli Lilly and Company Good Research Practices

[***]

Exhibit B
Research Plan

[***]

[***]

[***]

Exhibit C

Eli Lilly and Company Animal Care and Use Requirements for Animal Researchers and Suppliers

[***]

Exhibit D

Press Release

October XX, 2018

For Release: Immediately

Refer to: Mark Taylor; mark.taylor@lilly.com; (317) 276-5795 (Lilly Media)
Kevin Hern; hern_kevin_r@lilly.com; (317) 277-1838 (Lilly Investors)
Alex Van Rees; alex.vanrees@smithsolve.com; (973) 442-1555 ext. 11 (Dicerna Media)
Paula Schwartz; pschwartz@rxir.com; (917) 322-2216 (Dicerna Investors)

Lilly and Dicerna Announce RNAi Licensing and Research Collaboration

- *Companies will collaborate on RNAi research for cardio-metabolic, neurodegeneration and pain targets*
- *Dicerna to receive an upfront payment of $100 million and an equity investment of $100 million*
- *Dicerna eligible to receive up to approximately $350 million per target in development and commercialization milestones, plus royalties*

INDIANAPOLIS, IN, CAMBRIDGE, MA — Eli Lilly and Company (NYSE: LLY) and Dicerna Pharmaceuticals (NASDAQ: DRNA) today announced a global licensing and research collaboration focused on the discovery, development and commercialization of potential new medicines in the areas of cardio-metabolic disease, neurodegeneration and pain. The companies will utilize Dicerna's proprietary GalXC™ RNAi technology platform to progress new drug targets toward clinical development and commercialization. In addition, the partners will collaborate to move beyond the current technical paradigm in order to generate next-generation oligonucleotide therapeutic agents.

RNA interference (RNAi) is an emerging new approach to drug discovery, focused on a biologic process in which certain RNA molecules inhibit the expression of disease-causing genes by destroying the messenger RNAs (mRNAs) of those genes. RNAi has the potential to treat diseases by silencing some of the most well-validated, yet previously inaccessible drug targets.

"At Lilly, we go to where breaking science meets unmet medical needs," said Daniel M. Skovronsky, M.D., Ph.D., Lilly senior vice president and chief scientific officer. "We are excited to collaborate with Dicerna and utilize their RNAi expertise to study targets that up until now have proven to be very technically challenging. RNAi has the potential to treat an array of diseases that are of strategic importance to Lilly. Together with Dicerna, we aim to employ this emerging modality for greater success in drug development."

"The collaboration with Lilly provides an exceptional opportunity to leverage our proprietary GalXC platform in order to generate new medicines for cardio-metabolic diseases, and to establish a presence in new fields including neurodegeneration and pain," said Douglas M. Fambrough, Ph.D., President and Chief Executive Officer of Dicerna. "Lilly, with its demonstrated leadership in each of these fields, is an ideal partner for extending the range of Dicerna's proprietary GalXC technology, which is designed to silence the expression of disease-driving genes. We are eager and ready to expand and advance our pipeline of innovative GalXC-based therapies, including both proprietary and partnered programs."

Under the terms of the agreement, Dicerna will receive an upfront payment of $100 million, as well as an equity investment of $100 million at a premium. Dicerna is also eligible to receive up to approximately $350 million per target in development and commercialization milestones, as well as tiered royalties ranging from the mid-single to low-double digits on product sales. Dicerna will work exclusively with Lilly in the neurodegeneration and pain fields, and on select targets in cardio-metabolic diseases. The two companies anticipate collaborating on more than ten targets.

This transaction is subject to clearance under the Hart-Scott-Rodino Antitrust Improvements Act and other customary closing conditions. The transaction will be reflected in Lilly's reported results and financial guidance according to Generally Accepted Accounting Principles (GAAP). There will be no change to Lilly's 2018 non-GAAP earnings per share guidance as a result of this transaction.

About RNAi

RNA interference (RNAi) is a biologic process in which certain double-stranded RNA molecules inhibit the expression of disease-causing genes by destroying the messenger RNAs (mRNAs) of those genes. It reflects a new approach in the development of specific and powerful therapies. Rather than targeting and binding to proteins to inhibit their activity, RNAi exerts its effects one step earlier in the gene silencing process by targeting the mRNA, the instruction set that directs the building of the protein. By attaching to this instruction set, RNAi is believed to have the ability to attack any target, including disease-causing genes that are beyond the reach of conventional antibody and small-molecule modalities. Additionally, RNAi-based therapeutic approaches hold the potential to offer more convenience for patients via infrequent dosing and a long duration of effect.

About Dicerna's GalXC™ RNAi Technology Platform

The proprietary RNAi technology platform called GalXC™, invented by Dicerna, aims to advance the development of next-generation RNAi-based therapies designed to silence disease-driving genes in the liver. GalXC-based therapies are processed by the Dicer enzyme, which is the natural initiation point for RNAi within the human cell. Using GalXC, Dicerna scientists attach N-acetylgalactosamine sugars directly to the extended region of the proprietary Dicer substrate short-interfering RNA (DsiRNA) molecules, yielding multiple conjugate delivery configurations that allow flexible and efficient conjugation to the targeting ligands while stabilizing the RNAi duplex. Dicerna believes this stabilization will enable subcutaneous delivery of RNAi therapies to hepatocytes in the liver, where they are designed to specifically bind to receptors on target cells, potentially leading to internalization and access to the RNAi machinery within the cells. By using the Dicer enzyme as the entry point into RNAi, 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 rare diseases, viral infectious diseases, chronic liver diseases and cardiovascular diseases.

About Eli Lilly and Company

Lilly is a global healthcare leader that unites caring with discovery to make life better for people around the world. We were founded more than a century ago by a man committed to creating high-quality medicines that meet real needs, and today we remain true to that mission in all our work. Across the globe, Lilly employees work to discover and bring life-changing medicines to those who need them, improve the understanding and management of disease, and give back to communities through philanthropy and volunteerism. To learn more about Lilly, please visit us at www.lilly.com and http://newsroom.lilly.com/social-channels. C-LLY

About Dicerna Pharmaceuticals, Inc.

Dicerna Pharmaceuticals, Inc., is a biopharmaceutical company focused on the discovery and development of innovative, subcutaneously delivered RNAi-based therapeutics for the treatment of diseases involving the liver, including rare diseases, viral infectious diseases, chronic liver diseases, and cardiovascular diseases. Dicerna is leveraging its proprietary GalXC™ RNAi technology platform to build a broad pipeline in these core therapeutic areas, focusing on target genes where connections between target gene and diseases are well understood and documented. Dicerna intends to discover, develop and commercialize novel therapeutics either on its own or in collaboration with pharmaceutical partners. 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 therapeutic and commercial potential of GalXC™; (ii) research and development plans related to GalXC; (iii) the potential of RNAi therapies for the treatment of complement-mediated diseases; and (iv) the potential for the collaboration

between Lilly 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 SEC. 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.

Lilly Forward-Looking Statement

This press release contains forward-looking statements (as that term is defined in the Private Securities Litigation Reform Act of 1995) about the benefits of a collaboration between Lilly and Dicerna, and reflects Lilly's current beliefs. However, as with any such undertaking, there are substantial risks and uncertainties in the process of drug development and commercialization. Among other things, there can be no guarantee that Lilly will realize the expected benefits of the collaboration, or that the collaboration will yield commercially successful products. For a further discussion of these and other risks and uncertainties that could cause actual results to differ from Lilly's expectations, please see Lilly's most recent Forms 10-K and 10-Q filed with the U.S. Securities and Exchange Commission. Lilly undertakes no duty to update forward-looking statements.

# # #

Exhibit E
Existing Patents

[***]

[***]	[***]	[***]	[***]
[***]	[***]	[***]	[***]
[***]	[***]	[***]	[***]
[***]	[***]	[***]	[***]
[***]	[***]	[***]	[***]
[***]	[***]	[***]	[***]
[***]	[***]	[***]	[***]
[***]	[***]	[***]	[***]

Dicerna Cardiometabolic Target Patent Families

[***]	[***]	[***]	[***]

SHARE ISSUANCE AGREEMENT

THIS SHARE ISSUANCE AGREEMENT (this "**Agreement**"), is made as of October 25, 2018, by and between Eli Lilly and Company, an Indiana corporation (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) 5,414,185 shares (the "**Shares**") of the Company's common stock, par value $0.0001 per share ("**Common Stock**"), for an aggregate purchase price of $99,999,996.95 (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.

"**2016 Inducement Plan**" means the 2016 Inducement Plan of the Company, as adopted by the Board on March 4, 2016.

"**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.

"**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 in Boston, Massachusetts and New York, New York are open for business.

"**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.

"**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.

"**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. At the Closing, (a) the Company shall deliver or cause to be delivered to the Share Acquiror (i) the Shares in book-entry form; and (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; and (b) 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 not less than three (3) Business Days prior to the Closing Date.

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, 2018, 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, 2018, (A) 61,889,206 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 3,179,425 shares of Common Stock are reserved for future issuance under the Company's 2014 Performance Incentive Plan, 2014 ESPP and 2016 Inducement Plan; (E) 7,573,698 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. The Company has provided to the Share Acquiror a complete list of each direct and indirect Subsidiary of the Company, including its name and jurisdiction of incorporation or formation. 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, 2018, 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, 2018, 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) may 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) may 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. The representations of the company contained in Section 16 of the License Agreement are, subject to the exceptions and qualifications contained therein and disclosures related thereto, true, correct and complete.

4.18 Absence of Changes. Since December 31, 2017, 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, 2017, 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 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, to the knowledge of the Company, 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.

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 corporation duly organized, validly existing and in good standing under the laws of Indiana. 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 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.

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. The Share Acquiror is a United States person (as defined by Section 7701(a)(30) of the

Code).

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.

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 institutional 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 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 shall use reasonable efforts to take such further necessary action as the Share Acquiror may reasonably request in connection with the removal of any restrictive legend on the Shares being sold, 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. Notwithstanding the foregoing, the Company shall not have any obligations pursuant to this Section 6.7 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.

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. 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.

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, 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.

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 Delaware, 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 Court of Chancery of the State of Delaware. 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 Court of Chancery of the State of Delaware 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); (c) when sent, if sent by facsimile (provided confirmation of transmission is mechanically or electronically generated and kept on file by the sending party); or (d) 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:

Eli Lilly and Company
Lilly Corporate Center
Indianapolis, IN 46285
Attention: General Counsel
Facsimile No.: (317) 433-3000
e-mail:

with a copy (which shall not constitute notice) to:

Weil, Gotshal & Manges, LLP
767 Fifth Avenue

New York, NY 10153
Attention: Raymond O. Gietz
e-mail: Raymond.Gietz@weil.com

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:

Sidley Austin LLP
1001 Page Mill Road, Building 1, Suite 100
Palo Alto, California 94304
Attention: Sam Zucker
Facsimile: (650) 565-7100
e-mail: szucker@sidley.com

Written confirmation of receipt (i) given by the recipient of such notice, (ii) mechanically or electronically generated by the sender's facsimile machine containing the time, date and recipient facsimile number or (iii) provided by an overnight courier service shall be rebuttable evidence of personal service, receipt by facsimile or receipt from an overnight courier service in accordance with clause (a), (c) or (d) 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 facsimile transmission or 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 Fambrough
Name: Douglas Fambrough
Title: Chief Executive Officer

Eli Lilly and Company, an Indiana corporation

By:/s/ David A. Ricks
Name: David A. Ricks
Title: Chairman & CEO, Eli Lilly

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, facsimile 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, directors, agents, partners, members, stockholders and employees, as applicable, and each Person who controls the Share Acquiror (within the meaning of the Securities Act or the Exchange Act), and the officers, directors, agents, partners, members, stockholders and employees 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 through the facilities of the New York Stock Exchange 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*]

Contract number: 43085381

ADDITIONAL TARGET AGREEMENT

between

Boehringer Ingelheim International GmbH

Binger Strasse 173,
55216 Ingelheim am Rhein,
Germany
("**BOEHRINGER**")

VAT-ID-No.: DE 811138149

and

Dicerna Pharmaceuticals Inc.

87 Cambridgepark Drive
Cambridge, MA 02140
USA
("**DICERNA**")

– each also hereinafter referred to as "**Party**" or collectively as "**Parties**" –

This additional target agreement (the "**ATA**") is made on December 31, 2018 (the "**Effective Date**") under the terms and conditions herein by and between **Boehringer Ingelheim International GmbH** having a principal place of business at Binger Strasse 173, 55216 Ingelheim, Germany, (hereinafter referred to as "**BOEHRINGER**"), and **Dicerna Pharmaceuticals Inc.**, 87 Cambridgepark Drive, Cambridge, MA 02140, USA (hereinafter referred to as "DICERNA").

RECITALS

WHEREAS the Parties have entered into that certain collaborative research and license agreement to engage in a Research Program to develop Candidate Products directed to Targets, contract number 43085381 and effective as of October 27, 2017 (the "**Existing Agreement**").

WHEREAS BOEHRINGER, on 19 October 2018 has exercised the Target Option pursuant to Section 2.2 of the Existing Agreement for the additional target [***].

WHEREAS the Parties wish to agree on the Research Work Plan and the financial terms for the Additional Target in this ATA.

WHEREAS the Parties wish to amend the Existing Agreement and agree on a replacement Candidate Product Option and an Additional Target Option for BOEHRINGER.

NOW, THEREFORE, the Parties hereto agree as follows:

1. **Definitions**. Terms defined in this ATA are used with those meanings in this ATA. Terms not defined in this ATA are used with the meanings as defined in the Existing Agreement.

2. **Additional Target**. The additional target under the Target Option is [***] (the "**Additional Target**").

3. **Research Work Plan**. The Research Program for the Additional Target shall be conducted by the Parties in accordance with the Research Work Plan attached hereto as **APPENDIX 1**. The Parties may update and amend the Research Work Plan from time to time by mutual written agreement.

4. **Deliverables**. The Deliverables from DICERNA for the Candidate Products for the Additional Target are as follows:

    4.1 DICERNA will deliver to BOEHRINGER Candidate Products for further development to achieve [***] with the Research Work Plan.

    4.2 DICERNA will deliver to BOEHRINGER the corresponding reports for the Candidate Products that meet the Candidate Criteria.

5. **Resource Allocation**. Resources shall be allocated in accordance with the Research Work Plan and the agreed upon estimated timelines.

   5.1 The Parties agree that FTE expenses not listed in the Research Work Plan are valued in terms of the Target Option Fee under Section 5.1 below, and the [***] Milestone Payments under Sections 5.2.1 and 5.2.2 below. The Parties also agree that certain FTE and ancillary expenses listed in the Research Work Plan and marked "reimbursable by BI" will be reimbursable. All other FTE and ancillary expenses are not reimbursable during the Research Program Term. Ancillary expenses incurred during the Development Period for the Replacement Target as listed in the Replacement Target Research Plan will be reimbursable by BOEHRINGER.

   5.2 For the Additional Target (in addition to the Target under the Existing Agreement) during the Development Period, DICERNA shall provide FTE support up to [***] hours per annum at no additional costs to BOEHRINGER. Any additional costs to be incurred by BOEHRINGER must be pre-approved in writing.

6. **Payments.** With regard to the Additional Target, BOEHRINGER shall make to DICERNA the following payments under this Section 6:

   6.1 **Target Option Fee.** After execution of the ATA and within thirty (30) days following the receipt of a corresponding Invoice, BOEHRINGER shall pay to DICERNA, a one-time non-refundable, non-reimbursable and non-creditable payment of 5,000,000 US dollars (US$ five million) in accordance with Section 4.3 of the Existing Agreement.

   6.2 **Milestone Payments**. With regard to the Additional Target, BOEHRINGER shall make one-off non-refundable milestone payments (each, a "**Milestone Payment")** to DICERNA upon the occurrence of each of the milestones events (each, a "**Milestone Event**") as set forth below in this Section 6.2 and under the further terms and conditions of the Existing Agreement.

      6.2.1 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after Start of Development of the first Candidate Product for the Additional Target.

      6.2.2 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after Start of Development of the second Candidate Product for the Additional Target.

      6.2.3 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after Initiation of the first Phase I Clinical Trial of a Product for the Additional Target.

      6.2.4 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after Initiation of the first Phase II Clinical Trial of a Product for the Additional Target.

6.2.5 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after Initiation of the first Phase III Clinical Trial of a Product for the Additional Target.

6.2.6 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after the First Commercial Sale of a Product for the Additional Target in the USA.

6.2.7 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after the First Commercial Sale of a Product for the Additional Target in Europe, including the European Economic Area countries and the United Kingdom.

6.2.8 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after the First Commercial Sale of a Product for the Additional Target in Japan.

6.2.9 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after the aggregate annual Net Sales of a Product for the Additional Target in a Calendar Year in the Territory exceed [***] US dollars (US$ [***]).

6.2.10 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after the aggregate annual Net Sales of a Product for the Additional Target in a Calendar Year in the Territory exceed [***] US dollars (US$ [***]).

6.2.11 BOEHRINGER shall pay to DICERNA a Milestone Payment in the amount of [***] US dollars (US$ [***]) after the aggregate annual Net Sales of a Product for the Additional Target in a Calendar Year in the Territory exceed [***] US dollars (US$ [***]).

6.3 **Royalties.** As further consideration for the rights granted by DICERNA to BOEHRINGER hereunder BOEHRINGER shall pay to DICERNA the following royalties on aggregate annual Net Sales in the Territory of each Product for the Additional Target in the amount set forth below.

6.3.1 [***] on the portion of the aggregate annual Net Sales in the Territory of a Product for the Additional Target up to [***] US dollars (US$ [***]);

6.3.2 [***] on the portion of the aggregate annual Net Sales in the Territory of a Product for the Additional Target between [***] US dollars (US$ [***]) and [***] US dollars (US$ [***]);

6.3.3 [***] on the portion of the aggregate annual Net Sales in the Territory of a Product for the Additional Target between [***] US dollars (US$ [***]) and [***] US dollars (US$ [***]); and

6.3.4 [***] on the portion of the aggregate annual Net Sales in the Territory of a Product for the Additional Target which exceeds [***] US dollars (US$ [***])

7. The following new Section 2.2A shall be added to the Existing Agreement:

2.2A ***Additional Target Option***. *From time to time during the JRSC meetings, DICERNA may present to BOEHRINGER data on additional targets and DICERNA grants BOEHRINGER an option [***] (the "**Additional Target Option**") to add an additional target cleared by an independent third party gatekeeper. The Additional Target Option may be exercised by BOEHRINGER by sending written notice to DICERNA of its election to exercise the Additional Target Option, which notice shall identify the additional target. Upon BOEHRINGER's exercise of the Additional Target Option, the Parties shall:*

(i) *develop and agree to a Research Work Plan for the additional target,*

(ii) *agree to the budget for costs and expenses associated with the Research Work Plan, and*

(iii) *negotiate in good faith the milestones and royalties associated with the additional target,*

in the case of each of Section 2.2A(i) - (iii) not longer than one hundred and twenty (120) days after BOEHRINGER's triggering of the Additional Target Option.

*Upon completion of the activities according to Section 2.2A(i) – (iii) above and after mutual agreement of the Research Work Plan and financial terms for the additional target, an Additional Target Option fee in the amount of [***] US dollars (US$ [***]) shall be due (the "**Additional Target Option Fee**"). Upon payment of the Additional Target Option Fee by BOEHRINGER to DICERNA, such additional target shall become a Target under the Existing Agreement. For the avoidance of doubt, it is understood and agreed by the Parties that for such additional target no upfront payment and only the Additional Target Option Fee pursuant to this Section 2.2A will be paid by BOEHRINGER to DICERNA.*

8. The following new Sections 2.2B and 2.2C shall be added to the Existing Agreement:

2.2B ***Replacement Candidate Product Option***. *Should the First Candidate Product or the Second Candidate Product from the Existing Agreement or the ATA fail in development or in a Clinical Trial [***], DICERNA agrees to provide BOEHRINGER a replacement Candidate Product targeting the same Target as the failed Candidate Product subject to the*

terms and conditions of the agreement for such failed Candidate Product (i.e. the Existing Agreement, or the Existing Agreement and the ATA).

2.2C ***Replacement Candidate Product Fee***. *Upon provision by DICERNA to BOEHRINGER of a replacement Candidate Product pursuant to Section 7 above, and within thirty (30) days following the receipt of a corresponding Invoice, BOEHRINGER shall pay to DICERNA, a one-time non-refundable, non-reimbursable and non-creditable payment of [***] US dollars (US$ [***]).*

9. After execution of this ATA and payment of the Target Option fee in accordance with Section 6.1, the Additional Target shall become a Target under the Existing Agreement, as stipulated in Section 2.2 of the Existing Agreement, to which the further terms and conditions of the Existing Agreement apply. For the avoidance of doubt, in case of inconsistencies between this ATA and the Existing Agreement, the terms of this ATA shall prevail with regard to the Additional Target.

10. **Concluding Provisions.**

10.1 **Assignment.** Neither Party shall be entitled to assign or otherwise transfer its rights and/or obligations under this ATA in whole or in part to any Third Party without the prior written consent of the other Party, which consent shall not be unreasonably withheld, provided that, however, each Party may assign this ATA to (i) any Affiliate, and (ii) any successor corporation or entity resulting from any Change of Control of such Party, and provided that the Affiliate, entity or Third Party to which this ATA is assigned expressly agrees in writing to assume and be bound by all obligations of the assigning Party under this ATA. Each Party agrees to be responsible for the actions and omissions of its Affiliates under this ATA.

10.2 **Entire Agreement; Amendments**. This ATA sets forth the entire agreement between the Parties with regard to the Additional Target and supersedes all previous and contemporaneous negotiations, representations or agreements, written or oral, regarding the subject matter hereof. This ATA may be amended only by an instrument in writing duly executed on behalf of the Parties. In case of inconsistencies between this ATA and any Appendix hereof, the terms of this ATA shall prevail unless agreed to explicitly that the Appendix should prevail.

10.3 **Force Majeure**. Neither Party shall be liable or deemed in default for failure to perform any duty or obligation that such Party may have under this ATA where such failure has been occasioned by any act of God, fire, external strike, inevitable accidents, war, or any other cause outside the reasonable control of that Party, and occurring without its fault or negligence. The Party whose performance has so been interrupted shall give the other Party notice of the interruption and cause thereof, and shall use every reasonable means to resume full performance of this ATA as soon as possible.

10.4 **Waiver**. The failure of either Party to require performance by the other Party of any of that other Party's obligations under this ATA shall in no manner affect the right of such Party to enforce the same at a later time. No waiver by any Party of

any condition, or of the breach of any provision, term, representation or warranty contained in this ATA shall be deemed to be or construed as a further or continuing waiver of any such condition or breach, or of any other condition or of the breach of any other provision, term, representation, or warranty hereof. The remedies provided in this ATA are not exclusive and the Party suffering from a breach or default of this ATA may pursue all other remedies, both legal and equitable, alternatively or cumulatively.

10.5 **Severability**. In the event that any provision or portion thereof in this ATA is for any reason held to be invalid, illegal or unenforceable, the same shall not affect any other portion of this ATA and its validity, as it is the intent of the Parties that this ATA shall be construed in such fashion as to maintain its existence, validity and enforceability to the greatest extent possible. In any such event, this ATA shall be construed as if such provision of portion thereof had never been contained in this ATA, and there shall be deemed substituted therefore such provision as will most nearly carry out the intent of the Parties as expressed in this ATA to the fullest extent permitted by Applicable Law unless doing so would have the effect of materially altering the right and obligations of the Parties.

10.6 **Notices**. Any notices and Invoices given under this ATA shall be in writing and shall be addressed as follows (or at such other address for a Party as shall be specified by like notice, provided, however, that notices of a change of address shall be effective only upon receipt thereof):

If to DICERNA:

Dicerna Pharmaceuticals, Inc.
87 Cambridgepark Drive
Cambridge, MA 02140
Attention: President and Chief Executive Officer
Facsimile: [***]
E-mail:[***]

With a copy to:

Dicerna Pharmaceuticals, Inc.
87 Cambridgepark Drive
Cambridge, MA 02140
Attention: Legal Department

If to BOEHRINGER:

Boehringer Ingelheim International GmbH
Attn: Strategic Transactions and Alliance Management
Binger Strasse 173
55216 Ingelheim am Rhein
Germany

Fax: [***]

With a copy to:

Head of Legal
(Address as above)
Fax: [***]

10.7 **Governing Law**. This ATA shall be construed in accordance with and governed exclusively by the law of the State of New York, without reference to its rules of conflict of law.

10.8 **Dispute Resolution; Arbitration**. Any dispute arising out of or in connection with this ATA shall be settled, in accordance with Section 11.8 of the Existing Agreement.

10.9 **Independent Contractors**. In the performance of this ATA each Party shall be an independent contractor and that the relationship between the Parties shall not constitute a partnership, joint venture or agency. Therefore, no Party shall be entitled to any benefits applicable to any employees of the other Party. No Party is authorized to act as an agent for the other Party for any purpose, and no Party shall enter into any contract, warranty, representation, or commitment of any kind as to any matter on behalf of the other Party, without the prior written consent of the other Party.

10.10 **Third Party Beneficiaries.** None of the provisions of this ATA shall be for the benefit of or enforceable by any Third Party, including, without limitation, any creditor of either Party. No such Third Party shall obtain any right under any provision of this ATA or shall by reasons of any such provision make any claim in respect of any debt, liability or obligation (or otherwise) against either Party.

10.11 **Non-Employment**. Each Party shall at all times be and remain the sole employer of persons assigned to the performance of work by such Party hereunder and shall assume any and all obligations, responsibilities and risks to such employment and the possible termination thereof.

10.12 **Headings**. The captions to the Sections of this ATA are not a part of this ATA, but are merely for convenience to assist in locating and reading the several Sections of this ATA.

10.13 **Further Assurances**. Each of DICERNA and BOEHRINGER agrees to duly execute and deliver, or cause to be duly executed and delivered, such further instruments and do and cause to be done such further acts and things, including, without limitation, the filing of such additional assignments, agreements, documents and instruments, as the other Party may at any time and from time to time reasonably request in connection with this ATA or to carry out more effectively the provisions and purposes of, or to better assure and confirm unto such other Party its rights and remedies under this ATA. Each person executing

this ATA on behalf of a Party represents and warrants his/her capacity and authority to do so.

[The remainder of this page is intentionally blank. Signatures on the following page.]

IN WITNESS WHEREOF, the Parties have executed this ATA in duplicate originals by their duly authorized representatives as of the date and year first above written

Boehringer Ingelheim International GmbH

By: /s/ Dr. Jochen Gann

Name: Dr. Jochen Gann

Title: Head of CDept. Finance

Boehringer Ingelheim International GmbH

By: /s/ Dorothee Schwall-Rudolph

Name: Dorothee Schwall-Rudolph

Title: Head of Corp. Legal IU

Dicerna Pharmaceuticals Inc.

By: /s/ John B. Green

Name: John B. Green

Title: Chief Financial Officer

Appendices:

Appendix 1: Research Work Plan

APPENDIX 1

Research Work Plan

The Research Work Plan shall be added as an attachment no later than January 11, 2019.

Exhibit 21.1

SUBSIDIARIES OF DICERNA PHARMACEUTICALS, INC.

Name	Jurisdiction of Incorporation
Dicerna Security Corporation	Delaware
Dicerna Cayman	Cayman
Dicerna EU Limited	England
Dicerna Ireland Limited	Ireland

Exhibit 23.1

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We consent to the incorporation by reference in Registration Statement Nos. 333-202687, 333-214082, 333-223778, and 333-224989 on Form S-3 and in Registration Statement Nos. 333-193795, 333-210071, and 333-223648 on Form S-8 of our report dated March 13, 2019, relating to the consolidated financial statements of Dicerna Pharmaceuticals, Inc. and its subsidiaries appearing in this Annual Report on Form 10-K of Dicerna Pharmaceuticals, Inc. for the year ended December 31, 2018.

/s/ Deloitte & Touche LLP

Boston, Massachusetts
March 13, 2019

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, 2018;

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: March 13, 2019

/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, 2018;

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: March 13, 2019

/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, 2018, 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: March 13, 2019

/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.