UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 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, 2022

or

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**
FOR THE TRANSITION PERIOD FROM _ TO __

Commission file number 000-19319

Vertex Pharmaceuticals Incorporated

(Exact name of registrant as specified in its charter)

Massachusetts	**04-3039129**
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)
50 Northern Avenue, Boston, Massachusetts	**02210**
(Address of principal executive offices)	(Zip Code)

Registrant's telephone number, including area code **(617) 341-6100**

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

Title of Each Class	**Trading Symbol**	**Name of Each Exchange on Which Registered**
Common Stock, $0.01 Par Value Per Share	VRTX	The Nasdaq Global Select Market

Securities registered pursuant to Section 12(g) of the Exchange 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 Exchange 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 whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act (Check one):

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 has filed a report on and attestation to its management's assessment of the effectiveness of its internal control over financial reporting under Section 404(b) of the Sarbanes-Oxley Act (15 U.S.C. 7262(b)) by the registered public accounting firm that prepared or issued its audit report. ☒

If securities are registered pursuant to Section 12(b) of the Act, indicate by check mark whether the financial statements of the registrant included in the filing reflect the correction of an error to previously issued financial statements. ☐

Indicate by check mark whether any of those error corrections are restatements that required a recovery analysis of incentive-based compensation received by any of the registrant's executive officers during the relevant recovery period pursuant to § 240.10D-1(b). ☐

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

The aggregate market value of the registrant's common stock held by non-affiliates of the registrant based on the closing price on June 30, 2022 (the last business day of the registrant's most recently completed second fiscal quarter of 2022) was $71.8 billion.

As of January 31, 2023, the registrant had 257,091,441 shares of common stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the definitive proxy statement for the 2023 Annual Meeting of Shareholders, which we expect to hold on May 17, 2023, are incorporated by reference into Part III of this Annual Report on Form 10-K.

VERTEX PHARMACEUTICALS INCORPORATED

ANNUAL REPORT ON FORM 10-K

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"Vertex," "we," "us" and "our" as used in this Annual Report on Form 10-K refer to Vertex Pharmaceuticals Incorporated, a Massachusetts corporation, and its subsidiaries.

"VERTEX®," "KALYDECO®," "ORKAMBI®," "SYMDEKO®," "SYMKEVI®," "TRIKAFTA®" and "KAFTRIO®" are registered trademarks of Vertex. Other brands, names and trademarks contained in this Annual Report on Form 10-K are the property of their respective owners.

We use the brand name for our products when we refer to the product that has been approved and with respect to the indications on the approved label. Otherwise, including in discussions of our cystic fibrosis development programs, we refer to our compounds by their scientific (or generic) name or VX developmental designation.

This Annual Report on Form 10-K contains forward-looking statements. Words such as "anticipates," "may," "forecasts," "expects," "intends," "plans," "potentially," "believes," "seeks," "estimates," variations of such words and similar expressions are intended to identify such forward-looking statements, although not all forward-looking statements contain these identifying words. Please refer to "Special Note Regarding Forward-Looking Statements" set forth in Part I, Item 1A, for a discussion of our forward-looking statements and the related risks and uncertainties of such statements.

PART I

ITEM 1. BUSINESS

OVERVIEW

We are a global biotechnology company that invests in scientific innovation to create transformative medicines for people with serious diseases, with a focus on specialty markets. We have four approved medicines that treat the underlying cause of cystic fibrosis ("CF"), a life-threatening genetic disease, and we continue to focus on developing additional treatments for CF. Beyond CF, we have a pipeline that includes mid- and late-stage clinical programs in sickle cell disease, beta thalassemia, acute and neuropathic pain, APOL1-mediated kidney disease, type 1 diabetes, and alpha-1 antitrypsin deficiency, and earlier-stage programs in diseases such as muscular dystrophies.

Our goal in CF is to develop treatment regimens that will provide benefits to all people with CF and will enhance the benefits currently provided to people taking our medicines. Our marketed medicines are TRIKAFTA/KAFTRIO (elexacaftor/tezacaftor/ivacaftor and ivacaftor), SYMDEKO/SYMKEVI (tezacaftor/ivacaftor and ivacaftor), ORKAMBI (lumacaftor/ivacaftor) and KALYDECO (ivacaftor). Collectively, our CF medicines are being used to treat the majority of the approximately 88,000 people with CF in North America, Europe and Australia.

Through label expansions, approval of new medicines, and expanded reimbursement, we are focused on increasing the number of people with CF who are eligible and able to receive our medicines. We are evaluating our current medicines in additional patient populations, including younger children, with the goal of having small molecule treatments for all people who have at least one mutation in their cystic fibrosis transmembrane conductance regulator ("CFTR") gene that is responsive to our CFTR modulators. We are evaluating a once-daily triple combination of vanzacaftor/tezacaftor/deutivacaftor, formerly known as VX-121/tezacaftor/VX-561, in Phase 3 clinical trials. We believe this new triple-combination has the potential to provide enhanced benefits to CF patients who have at least one mutation in their CFTR gene. This regimen also carries a lower royalty burden. In addition, in December 2022, the U.S. Food and Drug Administration ("FDA"), cleared our Investigational New Drug Application ("IND") for VX-522, a messenger ribonucleic acid ("mRNA") therapeutic we are developing in collaboration with Moderna, Inc. ("Moderna"), that has the potential to benefit the approximately 5,000 people with CF in North America, Europe and Australia who cannot benefit from CFTR modulators.

Beyond CF, we are advancing programs across multiple disease areas and modalities, including:

- *Sickle Cell Disease and Beta Thalassemia.* We have completed enrollment in two ongoing Phase 3 clinical trials of exagamglogene autotemcel ("exa-cel"), formerly known as CTX001, an investigational CRISPR/Cas9-based gene-editing therapy for severe sickle cell disease ("SCD"), and transfusion-dependent beta thalassemia ("TDT"). In the fourth quarter of 2022, we completed European regulatory submissions for exa-cel and initiated a rolling submission in the United States (the "U.S."). The European Medicines Agency ("EMA") and the Medicines and Healthcare products Regulatory Agency ("MHRA") have validated the marketing authorization application ("MAA") for exa-cel.
- *Pain*. We are evaluating VX-548, a non-opioid, investigational NaV 1.8 inhibitor, for the treatment of pain. Our most advanced clinical trials in pain are three Phase 3 clinical trials of VX-548 as a potential treatment for moderate to severe acute pain. In addition, we have initiated a Phase 2 clinical trial evaluating VX-548 in chronic neuropathic pain.
- *APOL1-Mediated Kidney Disease.* We are evaluating inaxaplin, formerly known as VX-147, our investigational small molecule for the treatment of APOL1-mediated kidney disease ("AMKD") in a Phase 2/3 clinical trial.
- *Type 1 Diabetes.* We are evaluating VX-880, an investigational stem-cell derived fully-differentiated islet cell therapy, for the treatment of type 1 diabetes ("T1D") in a Phase 1/2 clinical trial in which patients receive immunosuppressive therapy to protect the islet cells from immune rejection. Our Clinical Trial Application ("CTA") in Canada for our second program in T1D, VX-264, in which the implanted islet cells are encapsulated in an immunoprotective device, was authorized and we plan to begin screening, enrollment and dosing in Canada in the coming months. In the U.S., the IND is on hold.

- *Alpha-1 Antitrypsin Deficiency.* We initiated a clinical trial for VX-634, which is the first in a series of next-wave investigational molecules with significantly improved potency and drug-like properties as compared to our previous Alpha-1 Antitrypsin ("AAT") correctors. We initiated a Phase 2 clinical trial of VX-864, a first-generation AAT corrector, to assess the impact of longer-term treatment on the liver, as well as the levels of functional AAT in the plasma.

- *Duchenne Muscular Dystrophy and Myotonic Dystrophy Type 1.* We are conducting IND-enabling studies for our first in vivo gene-editing therapy for Duchenne Muscular Dystrophy ("DMD"), and we expect to submit an IND for this program in 2023. We are exploring multiple approaches to address the underlying causal biology for Myotonic Dystrophy Type 1 ("DM1"), including small molecules.

- In addition to the programs listed above, we have a number of earlier-stage research programs aimed at diseases that fit our research and development strategy.

Our core strategy is to discover and develop innovative medicines by combining transformative advances in the understanding of human disease and the science of therapeutics to dramatically advance human health. That strategy focuses on validated targets that address causal human biology, predictive lab assays and clinical biomarkers, rapid paths to registration and approval, and product candidates that hold the potential for transformative patient benefit. We plan to continue investing to advance our strategy, fostering scientific innovation by identifying additional product candidates through internal research efforts, and investing in business development transactions to access emerging technologies, products and product candidates. Our research and early development strategy includes advancing multiple compounds or therapies from each program into early clinical trials to obtain patient data that can inform selection of the most promising compounds for later stage development as well as inform our ongoing discovery and development efforts. We aim to rapidly follow our first-in-class therapies that achieve proof-of-concept with potential best-in-class candidates. This serial innovation approach is intended to increase the likelihood of successfully bringing transformative medicines to patients and provide durable clinical and commercial success. We continue to invest in active research to identify additional candidate therapies in support of the clinical stage programs described above and in other targets that are consistent with our core research strategy.

MARKETED PRODUCTS

Our medicines are collectively being used by approximately two-thirds of people with CF in North America, Europe and Australia. Our approved medicines, including information regarding the indication and age groups for which the medicine is approved in the U.S. and Europe, are set forth in the table below.

Product	Scientific Name	Region/Initial Approval [1]	Indication	Eligible Age Group
trikafta®	elexacaftor/tezacaftor/ivacaftor and ivacaftor	U.S. (2019)	People with CF with (i) at least one F508del mutation, or (ii) another mutation that is responsive to elexacaftor/tezacaftor/ivacaftor and ivacaftor	6 years of age and older
kaftrio®	elexacaftor/tezacaftor/ivacaftor and ivacaftor	E.U. (2020)	People with CF with at least one F508del mutation	6 years of age and older
symdeko®	tezacaftor/ivacaftor and ivacaftor	U.S. (2018)	People with CF (i) homozygous for the F508del mutation or (ii) with at least one mutation that is responsive to tezacaftor/ivacaftor	6 years of age and older
symkevi®	tezacaftor/ivacaftor	E.U. (2018)	People with CF (i) homozygous for the F508del mutation or (ii) with one copy of the F508del mutation and one copy of certain mutations that result in residual CFTR activity	6 years of age and older
ORKAMBI®	lumacaftor/ivacaftor	U.S. (2015)	People with CF homozygous for the F508del mutation	1 year of age and older
	lumacaftor/ivacaftor	E.U. (2015)	People with CF homozygous for the F508del mutation	2 years of age and older
kalydeco®	ivacaftor	U.S. (2012)	People with CF with a mutation that is responsive to ivacaftor	4 months of age and older
	ivacaftor	E.U. (2012)	People with CF with R117H mutation or one of certain gating mutations	4 months of age and older

(1) At the end of the Brexit transition period on January 1, 2021, the MHRA, in Great Britain approved licenses for supply of each product in England, Scotland and Wales. The existing EMA licenses continue to authorize supply in Northern Ireland.

TRIKAFTA/KAFTRIO is now approved and reimbursed or accessible in more than 30 countries outside the U.S. In addition to the European Union (the "E.U.") and the U.S., we market our products in additional countries, including the United Kingdom (the "U.K."), Australia, and Canada. We continuously seek to increase the number of patients eligible and able to receive our current medicines through label expansions, approval of new medicines and expanded reimbursement. Since the beginning of 2022, events that have resulted from our efforts include:

- The European Commission and the MHRA granted marketing authorization for KAFTRIO for the treatment of children with CF 6 through 11 years of age who have at least one F508del mutation in the CFTR gene.
- Health Canada granted marketing authorization for TRIKAFTA for people with CF 6 through 11 years of age who have at least one F508del mutation.
- The FDA approved the use of ORKAMBI for children with CF 12 to less than 24 months of age who are homozygous for the F508del mutation in the CFTR gene.

- In the fourth quarter of 2022, we submitted global regulatory filings for TRIKAFTA/KAFTRIO in children with CF 2 to 5 years of age and for KALYDECO in children with CF from 1 month to less than 4 months of age.

RESEARCH AND DEVELOPMENT PROGRAMS

We invest in research and development to discover and develop transformative medicines for people with serious diseases, with a focus on specialty markets. Our research strategy is to combine transformative advances in the understanding of human disease and in the science of therapeutics to dramatically advance human health. This approach has been validated through our success in moving novel product candidates into clinical trials and obtaining marketing approvals for TRIKAFTA/KAFTRIO, KALYDECO, ORKAMBI, and SYMDEKO/SYMKEVI for the treatment of CF and INCIVEK (telaprevir) for the treatment of hepatitis C infection. Our approach to drug discovery has been further validated by our successful demonstration of clinical proof-of-concept in six additional disease areas: in SCD and beta thalassemia with exa-cel, in acute and neuropathic pain with our NaV1.8 inhibitors, in AMKD with inaxaplin, and in T1D with a stem cell-derived islet cell therapy.

We continue to research and develop small molecule product candidates for the treatment of serious diseases, including CF, pain, AMKD, AAT deficiency ("AATD") and DM1. Our research and development approach includes pursuing multiple modalities tailored to the specific disease target under investigation, using clinical and non-clinical data to inform drug discovery and development, and advancing multiple candidates into clinical trials with the goal of bringing first-in-class followed by best-in-class therapies to patients.

Over the last several years, we have expanded our capabilities to include additional innovative therapeutic modalities with a focus on cell and genetic therapies, which have the potential to treat, and in some cases, cure diseases by addressing the underlying cause of the disease. We have increased our internal investment in cell and genetic therapies, including establishment of a new research and current Good Manufacturing Practices ("cGMP") clinical manufacturing site in Boston, Massachusetts to bring together our portfolio of cell and genetic therapy technologies and teams. In addition, we have made several significant investments in external innovation, including:

- our collaborations with CRISPR Therapeutics AG ("CRISPR") to access and develop therapeutics based on the CRISPR gene-editing technology, including an agreement under which we now lead the worldwide development, manufacturing and commercialization of exa-cel;
- our establishment of cell therapy programs for T1D through our acquisition of Semma;
- our acquisition of ViaCyte, Inc. ("ViaCyte"), a biotechnology company with intellectual property, tools, technologies and assets with potential to accelerate development of our stem-cell based T1D programs;
- our advancement of our genetic therapy programs for DMD and DM1, through our acquisition of Exonics, and our collaboration with Entrada Therapeutics, Inc. ("Entrada"), focused on intracellular Endosomal Escape Vehicle ("EEV") therapeutics for DM1; and
- our collaboration with Moderna for the discovery and development of lipid nanoparticles and mRNAs that can deliver gene-editing therapies.

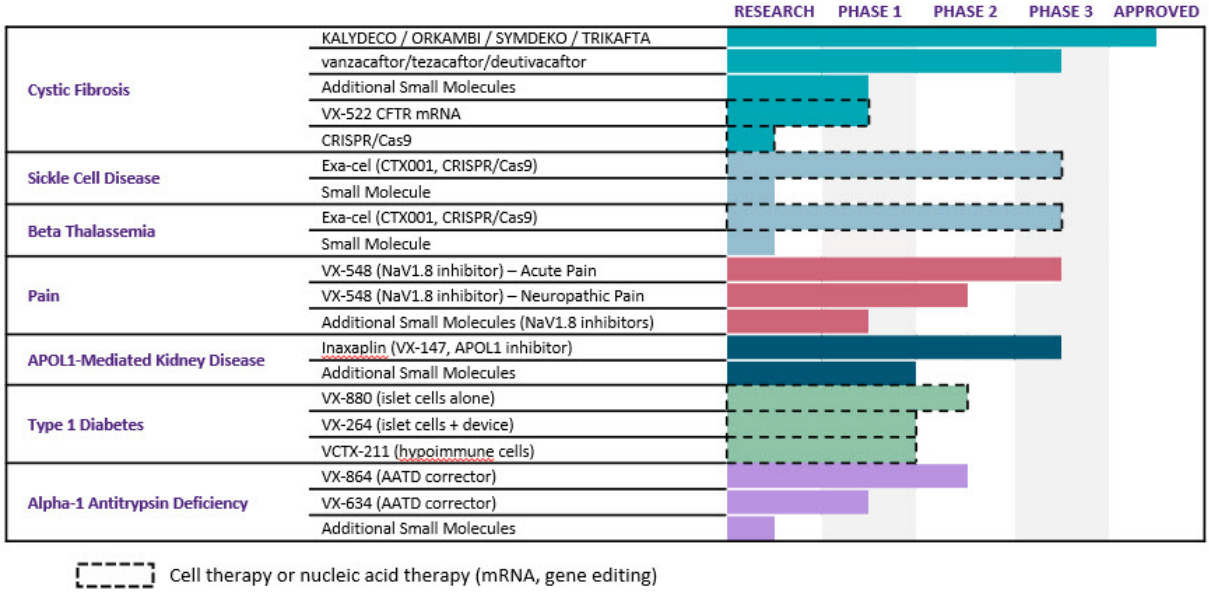
Consistent with our research and development strategy, all of our investments in research and development and in external innovation are designed to deliver a portfolio with greater likelihood of success. We focus on:

- validated targets that address causal human biology;
- predictive lab assays and clinical biomarkers;
- rapid path to registration and approval; and
- potential for transformative benefit regardless of modality.

To augment our internal programs, we plan to continue acquiring businesses and technologies and collaborating with biopharmaceutical and technology companies, leading academic research institutions, government laboratories, foundations and other organizations to advance research in our disease areas interest, as well as to access technologies needed to execute

on our strategy. We have established and we nurture such relationships with organizations around the world and intend to extend and leverage that experience to further our research efforts to discover transformational medicines for serious diseases. We will continue to identify and evaluate potential acquisitions and collaborations that may be similar to or different from the transactions that we have engaged in previously.

The following chart represents our pipeline programs by disease area, stage of development, and modality, for programs that have lead assets in the clinic.



CF Pipeline

CF is a life-shortening genetic disease caused by a defective or missing CFTR protein resulting from mutations in the CFTR gene. To develop CF, children must inherit two defective CFTR genes, which are referred to as alleles; one allele is inherited from each parent. The vast majority of patients with CF carry at least one F508del mutation. The F508del mutation results in a defect in the CFTR protein in which the CFTR protein does not reach the surface of the cells in sufficient quantities and does not adequately transport chloride ions.

The absence of working CFTR proteins results in poor flow of salt and water into and out of cells in a number of organs, including the lungs. As a result, thick, sticky mucus builds up and blocks the passages in many organs, leading to a variety of symptoms. In particular, mucus builds up and clogs the airways in the lungs, causing chronic lung infections and progressive lung damage. CFTR potentiators such as ivacaftor and deutivacaftor, formerly VX-561, increase the probability that the CFTR protein channels open on the cell surface, increasing the flow of salt and water into and out of the cell. CFTR correctors, such as lumacaftor, tezacaftor, elexacaftor, and vanzacaftor, formerly VX-121, increase the proper protein processing and folding of mutant CFTR proteins, such that a larger amount of functional CFTR protein reaches the cell surface.

We have completed enrollment of two Phase 3 global, randomized, double-blind, active-controlled clinical trials evaluating a once-daily investigational triple combination of vanzacaftor/tezacaftor/deutivacaftor. Clinical and preclinical data indicate that this triple combination has the potential to provide enhanced benefit beyond TRIKAFTA/KAFTRIO for people with CF who have the F508del mutation on at least one allele. Our Phase 3 program consists of two 52-week clinical trials, SKYLINE 102 and SKYLINE 103, which evaluate the safety and efficacy of the new combination relative to TRIKAFTA in approximately 950 people with CF 12 years of age and older. In parallel, we have initiated a clinical trial, RIDGELINE, evaluating vanzacaftor/tezacaftor/deutivacaftor in children with CF 6 to 11 years of age. We expect to complete the SKYLINE 102 and SKYLINE 103 clinical trials by the end of 2023. We continue to identify and develop additional CFTR modulators with the goal of achieving carrier levels of CFTR activity for people with CF who respond to CFTR modulators.

We continue to research genetic therapies, such as mRNA, and gene-editing approaches, to treat people with CF who do not make CFTR protein and, as a result, cannot benefit from our CFTR modulators. In collaboration with Moderna, we are developing VX-522, a CF mRNA therapeutic designed to treat the underlying cause of CF for these people by enabling cells in the lungs to produce functional CFTR protein. In December 2022, the FDA cleared our IND for VX-522. We have initiated a single ascending dose clinical trial for VX-522 in people with CF, which is active and enrolling patients. We expect to complete the single ascending dose clinical trial and initiate the multiple ascending dose clinical trial in 2023.

Sickle Cell Disease and Transfusion-Dependent Beta Thalassemia

SCD and beta thalassemia are hemoglobinopathies, a group of inherited blood disorders that result from gene mutations that alter hemoglobin, a protein in red blood cells that delivers oxygen throughout the body.

SCD is caused by the change of a single amino acid in the hemoglobin gene that causes red cells to change shape in settings of low oxygen. These sickled cells block blood flow and can lead to severe pain, organ damage, and shortened life span. Treatment is typically focused on relieving pain and minimizing organ damage, requiring medication and, for some patients, monthly blood transfusions and frequent hospital visits. We estimate that there are approximately 25,000 patients with severe SCD in the U.S. and Europe.

Beta thalassemia is caused by loss-of-function mutations in hemoglobin that lead to severe anemia in patients, which causes fatigue and shortness of breath. In infants, beta thalassemia causes failure to thrive, jaundice, and feeding problems. Complications of beta thalassemia can lead to an enlarged spleen, liver and/or heart, misshapen bones and delayed puberty. Treatment for beta thalassemia varies depending on the disease severity for each patient. Patients with TDT, the most severe form of the disease, require regular blood transfusions, as frequently as every two to four weeks. Repeated blood transfusions eventually cause an unhealthy buildup of iron in the patient, leading to organ damage. We estimate that there are approximately 7,000 patients with TDT in the U.S. and Europe.

We are developing exa-cel, an investigational CRISPR/Cas9-based gene-editing therapy, for the treatment of severe SCD and TDT, with our collaborator, CRISPR. Our therapeutic approach involves isolating hematopoietic stem and progenitor cells (“HSPCs”), which give rise to red blood cells, from a patient, treating those cells ex vivo with CRISPR/Cas9 to modify the erythroid-specific enhancer in the BCL11A gene, and reintroducing the edited cells back into the patient. This approach has the potential to significantly increase levels of fetal hemoglobin in erythrocytes and reduce or eliminate symptoms associated with disease.

We are investigating exa-cel in two Phase 3 open-label clinical trials designed to assess the safety and efficacy of a single dose of exa-cel in patients 12 to 35 years of age with severe SCD (the CLIMB SCD-121 clinical trial) and TDT (the CLIMB THAL-111 clinical trial), respectively. Patients enrolled in the clinical trials first undergo a treatment that mobilizes a population of HSPCs from the bone marrow into the bloodstream. Blood cells are collected from the patient’s bloodstream and transferred to a manufacturing facility where the HSPCs are purified and CRISPR/Cas9 gene-editing is performed. Following manufacturing, the edited cells, now called exa-cel, are transferred back to the clinical site. Patients are preconditioned with a treatment that ablates their bone marrow prior to infusion of exa-cel.

Efficacy data presented to date support the profile of exa-cel as a potential one-time functional cure for people with severe SCD and TDT. Exa-cel safety data to date is generally consistent with an autologous stem cell transplant and myeloablative conditioning. We completed regulatory submissions to the EMA and the MHRA for exa-cel for SCD and TDT in the fourth quarter of 2022, and both the EMA and MHRA have validated the MAA. We also initiated the submission of a biologics licensing application ("BLA") for exa-cel for SCD and TDT for rolling review by the FDA in November 2022, and we expect to complete the submission by the end of the first quarter of 2023. We are enrolling in two Phase 3 clinical trials of exa-cel in patients 5 to 11 years of age, one in SCD and a second in TDT.

Pain

Pain can be debilitating and develop from a variety of conditions. Patients with pain can be categorized as suffering from one of three types of pain: acute pain, chronic neuropathic pain (caused primarily by damage or dysfunction of the nervous system) or chronic musculoskeletal pain (caused primarily by damage to muscle, joints or bone). Acute pain usually resolves in days or weeks (for example, following surgery or an injury), while chronic pain generally lasts greater than three months due to unresolved or ongoing damage to tissues. Our lead program is in Phase 3 development in acute pain where available treatments may not work well, may cause significant side effects, and may carry the risk of addiction. In addition, there is the practice of over- and mis-utilization, as well as underutilization, of current acute pain medicines.

The sodium channels NaV1.8 and NaV1.7 play important roles in the physiology of pain. We have discovered multiple selective small molecule inhibitors of NaV1.8 as potential treatments for pain. We obtained pharmacological validation of NaV1.8 inhibition with one of our first generation NaV1.8 inhibitors in all three clinical pain types: acute pain, chronic neuropathic pain, and chronic musculoskeletal pain.

In early 2022, we reported positive data from two Phase 2 acute pain clinical trials for VX-548, a NaV1.8 inhibitor. Both Phase 2 trials met their primary endpoint and established proof-of-concept for VX-548 for the treatment of acute pain following bunionectomy or abdominoplasty surgery. In addition, VX-548 was generally well tolerated by patients in these studies. We have initiated two randomized, double-blind, placebo-controlled Phase 3 clinical trials evaluating the efficacy and safety of VX-548 for moderate to severe acute pain following bunionectomy or abdominoplasty surgery. The Phase 3 program for VX-548 also includes a single-arm study evaluating the safety and effectiveness of VX-548 in multiple other types of moderate to severe acute pain. We expect to complete these Phase 3 trials in late 2023 or early 2024. In the fourth quarter of 2022, we also initiated a Phase 2 clinical trial evaluating VX-548 in diabetic peripheral neuropathy, a common form of peripheral neuropathic pain.

APOL1-Mediated Kidney Disease

Inherited mutations in the APOL1 gene play a causal role in the biology of severe proteinuric kidney diseases referred to as AMKD. In AMKD, the kidney's filtering units known as the glomeruli, and within them, the cells known as podocytes, are damaged, leading to leakage of protein into the urine, deterioration in kidney function, scarring, and, ultimately, permanent kidney damage. Patients with proteinuria who inherited two copies of the APOL1 mutations demonstrate rapid progression to end stage kidney disease. Some patients with AMKD have the histological finding of focal segmental glomerulosclerosis ("FSGS") and co-morbidities such as hypertension. We are evaluating multiple novel small molecules that inhibit the function of APOL1 protein with the potential to treat APOL1-mediated kidney disease.

In a Phase 2 proof-of-concept clinical trial, patients with APOL1-mediated FSGS treated with inaxaplin on top of standard of care achieved a statistically significant, substantial, and clinically meaningful reduction of proteinuria. In this clinical trial, inaxaplin was well tolerated by patients. Based on this positive Phase 2 data, we initiated pivotal development of inaxaplin in a single Phase 2/3 adaptive clinical trial in patients with AMKD in 2022. We continue to enroll patients in this Phase 2/3 clinical trial and we expect to complete the Phase 2 dose-ranging portion of the trial in 2023.

Type 1 Diabetes

T1D is a chronic, metabolic disorder caused by an absence of insulin secretion by the beta cells in the pancreas. In patients with T1D, the insulin-producing islet cells of the pancreas are destroyed by the person's own immune system, resulting in a complete lack of insulin. While insulin therapy allows patients to live for decades with the disease, challenges of insulin therapy include inadequate control of blood sugar (both hyper- and hypo-glycemia), a substantial burden of care on patients and families, and long-term vascular complications.

We are developing fully differentiated stem-cell derived islet cell therapies designed to replace insulin-producing islet

cells that are destroyed in people with T1D, with the goal of delivering a functional cure. We are pursuing three programs for the transplant of functional islets into patients: transplantation of islet cells alone following immunosuppression to protect the implanted cells, implantation of the islet cells inside a novel immunoprotective device, and development of hypoimmune cells to optimize how we protect the implanted islet cells from the immune system.

VX-880, our first program, is a stem cell-derived, allogeneic, fully differentiated, insulin-producing islet cell replacement therapy, using standard immunosuppression to protect the implanted cells. Our Phase 1/2 clinical trial evaluating VX-880 as a potential treatment for T1D is ongoing and proof-of-concept has been achieved. In mid-2022, we provided data on the first two T1D patients dosed in this clinical trial, including that both patients had achieved glucose-responsive insulin production, improvements in glycemic control, and reductions in exogenous insulin requirements. VX-880 safety data to date is generally consistent with the immunosuppressive regimen used in the clinical trial. We have completed enrollment in Part B of the Phase 1/2 clinical trial and, after completion of Part B, we expect to begin Part C of the trial, with concurrent dosing, in 2023.

In our second program, we are evaluating VX-264, in which the stem cell-derived, fully differentiated, insulin-producing islet cells are encapsulated and implanted in an immunoprotective device. In December 2022, our Clinical Trial Application ("CTA") in Canada for this program was authorized and we plan to begin screening, enrollment and dosing in Canada in the coming months. In the U.S., the IND is on hold. In our third program, research in earlier stages is directed toward developing hypoimmune cells to further optimize how we protect the implanted islet cells from the immune system.

In the third quarter of 2022, we acquired ViaCyte, a biotechnology company focused on delivering novel stem cell-derived cell replacement therapies as a potential functional cure for T1D. We believe the acquisition will accelerate our goal of developing a functional cure for T1D. A Phase 1/2 clinical trial of VCTX-211, a hypoimmune cell program that we are developing in partnership with CRISPR, is active and enrolling patients.

Alpha-1 Antitrypsin Deficiency

AATD is a severe disease of the liver and lung, caused by inherited mutations in the SERPINA1 gene that encodes the AAT protein. People who inherit two mutant SERPINA1 alleles (one from each parent) develop AATD. Most people who develop AATD have two copies of a single mutation known as the Z allele. The Z-AAT mutation results in a protein folding defect in the AAT protein leading the misfolded AAT protein to accumulate in the liver (where it is produced at high levels), which can cause liver damage. As a result, the protein fails to reach other organs in adequate quantity and function, particularly the lungs, where the AAT protein's normal role is to protect the lungs from the digestive effects of certain proteases. The unchecked activity of these proteases can cause auto-digestion of lung tissue and may lead to emphysema or chronic pulmonary obstructive disease, and lung infections over time. Currently, there is no treatment that targets the underlying cause of the disease in both the liver and the lung. Available treatments are aimed at transiently increasing levels of AAT in the blood but have no effect in the liver. Patients living with AATD typically experience recurring hospital visits and a shortened life expectancy.

We seek to develop medicines that treat the underlying cause of AATD throughout the body. We have discovered multiple small molecule correctors that restore folding of the mutant AAT protein, leading to increased production of functional AAT protein. The restoration of AAT protein folding in the liver and of systemic AAT function has the potential to benefit both the liver and lung diseases caused by AATD. We have initiated a Phase 1 clinical trial for VX-634, which is the first in a series of next-wave investigational molecules with significantly improved potency and drug-like properties as compared to our previous AAT correctors, allowing potential exploration of the full dose response. We also have initiated a second Phase 2 clinical trial of VX-864, a first-generation AAT corrector, to assess the impact of longer-term treatment on the liver, as well as the levels of functional AAT in the plasma.

Duchenne Muscular Dystrophy and Myotonic Dystrophy Type 1

DMD and DM1 are inherited diseases that result in the weakening and breakdown of skeletal muscles over time. In 2019, we acquired Exonics and expanded our collaboration with CRISPR and are focused on advancing gene-editing therapies aimed at treating the underlying cause of DMD by restoring expression of near-full length dystrophin protein. We have an internal small molecule program (and, as described below, we established a collaboration with Entrada) to address the functional impact of the causal mutation in the gene that causes DM1.

We are conducting enabling studies for our first in vivo gene-editing therapy for DMD and we expect to submit an IND for this program in 2023.

We have established a collaboration with Entrada focused on intracellular EEV therapeutics for DM1, which includes ENTR-701, an EEV-investigational candidate for the treatment of DM1 in late preclinical development.

COMMERCIALIZATION OF OUR MEDICINES

Commercial Organization

Our commercial organization focuses on supporting the appropriate use of TRIKAFTA/KAFTRIO, SYMDEKO/SYMKEVI, ORKAMBI and KALYDECO in the markets where these products have been approved. Our sales and marketing organizations are responsible for promoting products to health care providers, ensuring our products are distributed effectively, and obtaining reimbursement for our products from third-party payors, including governmental organizations in the U.S. and ex-U.S. markets. In the U.S., we sell our products primarily to a limited number of specialty pharmacy and specialty distributors. In international markets, we sell our products primarily through distributor arrangements and to retail pharmacies or pharmacy chains, as well as to hospitals and clinics, many of which are government-owned or supported.

Our U.S. field-based CF commercial team is comprised of a small number of individuals to support commercialization of our medicines for CF. We focus our CF marketing efforts in the U.S. on a relatively small number of physicians and health care professionals who write most of the prescriptions for CF medicines. Many of these physicians and health care professionals are located at a limited number of accredited centers in the U.S. focused on the treatment of CF. In international markets, we or our distributors have small sales forces that support TRIKAFTA/KAFTRIO, SYMDEKO/SYMKEVI, ORKAMBI and KALYDECO in jurisdictions where these products are approved.

We market our products through personal interactions with physicians and allied health care professionals. In parallel, our government affairs and public policy group advocates for policies that promote life sciences innovation and increase awareness of the diseases on which we are focusing with state and federal legislatures, government agencies, public health officials and other policymakers. We also have established programs in the U.S. that provide our products to qualified uninsured or underinsured patients at no charge or at a reduced charge, based on specific eligibility criteria.

We also continue to prepare for the near-term launch opportunities presented by exa-cel for SCD and TDT, VX-548 for acute pain, and the triple combination of vanzacaftor/tezacaftor/deutivacaftor for CF. For example, we are expanding our commercial organization and capabilities to ensure launch readiness in preparation for the launch of exa-cel, which will focus on patients with severe forms of sickle cell disease and beta thalassemia in the U.S. and certain countries in Europe. The number of patients with severe disease and the geographic concentration of patients enables a specialty model and we are creating the infrastructure and support systems that we believe will lead to commercial success. Our field teams are actively engaged with key treatment centers, policymakers and third-party payors to ensure that stakeholders understand the significant burden of these diseases and to ensure that patients who may be eligible for exa-cel have access to this potentially curative therapy.

Reimbursement

Sales of our products depend, to a large degree, on the extent to which our products will be reimbursed by third-party payors, such as government health programs, commercial insurance, and managed health care organizations. Increasingly, these third-party payors are becoming stricter in the ways they evaluate and reimburse medical products and services. Additionally, the containment of health care 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. Adoption of price controls and cost-containment measures, and adoption of more restrictive policies in jurisdictions with existing controls and measures, could limit our revenues. Decisions by third-party payors to not cover a product could reduce physician usage of the product.

Our CF medicines are broadly reimbursed by third-party payors in the U.S., including the federal government. We participate in the Medicaid Drug Rebate program, Medicare, and other governmental pricing programs. Medicaid is a joint federal and state program that is administered by the states for low-income and disabled beneficiaries. Under the Medicaid Drug Rebate program, we are required to pay a rebate to each state Medicaid program for our covered outpatient drugs that are dispensed to Medicaid beneficiaries as a condition of having federal funds being made available to the states for our drugs. Medicaid rebates are based on pricing data reported by us on a monthly and quarterly basis to the Centers for Medicare

& Medicaid Services (“CMS”), the federal agency that administers the Medicaid and Medicare programs.

Any company that participates in the Medicaid Drug Rebate program also must participate in the 340B drug pricing program (the “340B program”), and the Federal Supply Schedule (“FSS”) pricing program. The 340B program, which is administered by the Health Resources and Services Administration, requires participating companies to agree to charge statutorily defined covered entities no more than the 340B “ceiling price” for our covered outpatient drugs. The 340B ceiling price is calculated using a statutory formula, which is based on pricing data calculated under the Medicaid Drug Rebate program. The FSS pricing program, which is administered by the Department of Veterans Affairs (“VA”), also requires participating companies to extend discounted prices to the VA, Department of Defense, Coast Guard, and Public Health Service. Similar to the 340B program, FSS prices are calculated utilizing pricing data reported by us to the VA on a quarterly and annual basis.

The Medicare Part D program provides a voluntary prescription drug benefit to Medicare beneficiaries. Under Part D, Medicare beneficiaries may enroll in prescription drug plans offered by private entities, which provide coverage of outpatient prescription drugs such as our CF medicines. 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, including CF, 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 therapeutics committee. U.S. government payment for some of the costs of prescription drugs may increase demand for products for which we receive marketing approval. However, any negotiated prices for our products covered by a Part D prescription drug plan likely will be lower than the prices we might otherwise obtain.

Private payors often follow Medicare coverage policy and payment limitations in setting their own payment rates. As a result, any reduction in payment that results from Part D reimbursement may result in a similar reduction in payments from non-governmental payors for our products. Additionally, private payors, including health maintenance organizations and pharmacy benefit managers in the U.S., are adopting more aggressive utilization management techniques and are increasingly applying restrictive plan designs that can impact patients and manufacturers. They continue to push for significant discounts and rebates from manufacturers. As a consequence, these payors may not cover or adequately reimburse for use of our products or may do so at levels that disadvantage them relative to competitive products.

The U.S. government has shown significant interest in implementing cost-containment programs for medicines and has enacted reforms at the state and federal level designed to, among other things, modify prescription drug reimbursement amounts and methodologies, and otherwise control health care costs. For example, the American Recovery and Reinvestment Act of 2009 provided funding for the federal government to compare the effectiveness of different treatments for the same illness. Although the results of the comparative effectiveness studies are not intended to mandate coverage policies for public or private payors, it is not clear what effect, if any, the research will have on the sales of our products. In the future, it is possible that comparative effectiveness research demonstrating benefits of a competitor’s product could adversely affect the sales of our products. If third-party payors do not consider our products to be cost-effective compared to other available therapies, they may not cover our products 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 Patient Protection and Affordable Care Act (“ACA”) was enacted in March 2010 and was designed to expand coverage for the uninsured while at the same time containing overall health care costs. With regard to pharmaceutical products, among other things, the ACA was designed to expand and increase industry rebates for drugs covered under Medicaid programs, impose an annual fee on branded pharmaceutical manufacturers, subject biological products to potential competition by lower-cost biosimilars, and make changes to the coverage requirements under the Medicare Part D program. We anticipate that the U.S. government will continue to engage in activities seeking to address drug pricing and reimbursement.

In Europe and other foreign jurisdictions, the success of our products depends largely on obtaining and maintaining government reimbursement, because patients are generally unable to access prescription pharmaceutical products that are not reimbursed by their governments. In some countries, such as Germany, commercial sales of a new product may begin while pricing and reimbursement terms are under discussion. In other countries, a company must complete reimbursement negotiations prior to the commencement of commercial supply of the pharmaceutical product. The requirements governing drug pricing vary widely country-by-country and region-by-region. For example, the member states of the E.U. can restrict the range of drugs for which their national health insurance systems provide reimbursement and can control the prices of

prescription drugs. In addition, many ex-U.S. government payors require companies to provide health economic assessments of products, which are evaluated by government agencies set up for this purpose. A member state may approve a specific price for the drug, or it may instead adopt a system of direct or indirect controls on the total amount of money that a company may receive for supply of a drug. Countries also may consider increasing mandatory discounts over time in an attempt to manage increased demands on healthcare budgets. Reimbursement discussions in foreign countries often result in a reimbursement price that is lower than the net price that companies can obtain for the product in the U.S. In addition, reimbursement discussions may take a significant period of time resulting in commercialization delays. Reimbursement for our products cannot be assured because a country or region may only provide for reimbursement on terms that we do not deem adequate. Further, many ex-U.S. governments have introduced or are in the process of introducing legislation focusing on cost containment measures in the pharmaceutical industry. The impact of these laws where finalized, the final form of laws under consideration, and their relevant practical application, are unknown at this time, but may lead to lower prices, paybacks, or other forms of discounts or special taxes.

We have obtained broad reimbursement for our CF medicines in ex-U.S. markets. TRIKAFTA/KAFTRIO is reimbursed or accessible in more than 30 countries outside the U.S. We expect to continue to focus significant resources to obtain expanded reimbursement for our CF medicines and pipeline therapies in ex-U.S. markets.

There is significant uncertainty related to the insurance coverage and reimbursement of our pipeline cell or genetic therapy products, including genetic therapies that are potential one-time treatments. It is difficult to predict how future novel cell and genetic therapy products will be covered and reimbursed by payors, including U.S. federal healthcare programs, ex-U.S. governments, or private insurance companies. Additionally, reimbursement rates for cell and genetic therapies approved before ours could create an adverse environment for reimbursement of any therapies we ultimately commercialize. The administration of our products may require procedures for the collection of cells from patients, followed by other procedures either before or after delivery of the cell or genetic therapy. The manner and level at which reimbursement is provided for these services also are important. An inadequate reimbursement for such services may adversely affect physicians' decisions to recommend any product for which we obtain approval in the future and our ability to market or sell the related cell or genetic therapy.

STRATEGIC TRANSACTIONS AND COLLABORATIONS

As part of our business strategy, we seek to license or acquire technologies, products, product candidates, and businesses that are aligned with our corporate and research and development strategies and complement and advance our ongoing research and development efforts. In addition, we establish business relationships with collaborators to support our research activities and to lead or support development and/or commercialization of certain product candidates. We expect to continue to identify and evaluate potential acquisitions, licenses and collaborations that may be similar or different from the transactions that we have engaged in previously.

Strategic Transactions

- In 2017, we enhanced our CF portfolio through our acquisition of certain CF assets, including deutivacaftor, from Concert Pharmaceuticals Inc. We are in Phase 3 clinical trials evaluating our new, once-daily investigational triple combination therapy, which includes deutivacaftor, for people with CF 12 years of age and older.
- In 2019, we established our T1D program through our acquisition of Semma, a privately held company focused on the use of stem cell-derived human islets as a potentially curative treatment for T1D. We are evaluating VX-880 for the potential treatment of T1D in a Phase 1/2 clinical trial. In addition, we submitted an IND for our second program in T1D, VX-264, in which the implanted islet cells are encapsulated in an immunoprotective device.
- In 2019, we enhanced our gene-editing capabilities through our acquisition of Exonics, a privately held company focused on creating transformative gene-editing therapies to repair mutations that cause DMD and other severe neuromuscular diseases, including DM1. We are conducting enabling studies for our first in vivo gene-editing therapy for DMD and we expect to submit an IND for this program in 2023.
- In 2022, we acquired ViaCyte, a privately held company focused on delivering novel stem cell-derived cell replacement therapies as a functional cure for T1D, and Catalyst Biosciences, Inc.'s portfolio of protease medicines that target the complement system and related intellectual property.

Collaboration and Licensing Arrangements

Joint Development and Commercialization Agreement with CRISPR

In December 2017, we entered into a joint development and commercialization agreement ("Original JDCA"), with CRISPR pursuant to which we are co-developing and preparing to co-commercialize exa-cel, for SCD and TDT. We entered into the Original JDCA following our exercise of an option to co-develop and co-commercialize the hemoglobinopathies program that was contained in the collaboration agreement that we entered into with CRISPR in 2015.

In April 2021, we and CRISPR amended and restated the Original JDCA (the "A&R JDCA"). Pursuant to the A&R JDCA, the parties agreed to, among other things, (a) adjust the governance structure for the collaboration and adjust the responsibilities of each party thereunder; (b) adjust the allocation of net profits and net losses between the parties; and (c) exclusively license (subject to CRISPR's reserved rights to conduct certain activities) certain intellectual property rights to us relating to the products that may be researched, developed, manufactured and commercialized under such agreement.

Pursuant to the A&R JDCA, we lead global development, manufacturing and commercialization of exa-cel, with support from CRISPR. Subject to the terms and conditions of the A&R JDCA, we have the right to conduct all research, development, manufacturing and commercialization activities relating to the product candidates and products under the A&R JDCA (including exa-cel) throughout the world, subject to CRISPR's reserved right to conduct certain activities.

In connection with the A&R JDCA, we made a $900.0 million upfront payment to CRISPR in the second quarter of 2021. CRISPR has the potential to receive an additional one-time $200.0 million milestone payment upon receipt of the first marketing approval of exa-cel from the FDA or the European Commission.

We and CRISPR shared equally all expenses incurred under the Original JDCA. On July 1, 2021, with respect to exa-cel, the net profits and net losses incurred pursuant to the A&R JDCA began to be allocated 60% to us and 40% to CRISPR, subject to certain adjustments, while all other product candidates and products continue to have net profits and net losses shared equally between the parties.

Either party may terminate the A&R JDCA upon the other party's material breach, subject to specified notice and cure provisions, or, in our case, in the event that CRISPR becomes subject to specified bankruptcy, winding up, or similar circumstances. Either party may terminate the A&R JDCA in the event the other party commences or participates in any action or proceeding challenging the validity or enforceability of any patent that is licensed to such challenging party pursuant to the A&R JDCA. We also have the right to terminate the A&R JDCA for convenience at any time after giving prior written notice. If circumstances arise pursuant to which a party would have the right to terminate the A&R JDCA on account of an uncured material breach, such party may elect to keep the A&R JDCA in effect and cause such breaching party to be treated as if it had exercised its opt-out rights with respect to the products associated with such uncured material breach and the royalties payable to the breaching party would be reduced by a specified percentage.

Either party may opt out of the development of a product candidate under the A&R JDCA after predetermined points in the development of the product candidate, on a candidate-by-candidate basis. In the event of such opt-out, the party opting-out will no longer share in the net profits and net losses associated with such product candidate and, instead, the opting out party will be entitled to high single to mid-teen percentage royalties on the net sales of such product, if commercialized.

In-License Agreements

We have entered into various agreements pursuant to which we have obtained access to technologies from third parties and are conducting research and development activities with collaborators. Pursuant to these arrangements, we have obtained development and commercialization rights to resulting product candidates. Depending on the terms of the arrangements, we may be responsible for the costs of research activities, required to make upfront payments and/or milestone payments upon the achievement of certain research, development, and commercial objectives, and/or pay royalties on future sales, if any, of commercial products resulting from the collaboration. Our current in-license agreements include:

- CRISPR Therapeutics AG. In addition to our arrangement with CRISPR described above, we have exercised options to exclusively license treatments for specific targets, including CF, that were subject to the research program under the collaboration agreement we entered into with CRISPR in 2015. In 2019, we obtained exclusive worldwide rights to CRISPR's intellectual property for DMD and DM1 gene-editing products through a new agreement with CRISPR.

- Moderna, Inc. In 2016, we entered into a collaboration with Moderna for the identification and development of mRNA therapeutics encoding CFTR for the treatment of CF. In December 2022, the FDA cleared our IND for VX-522, an mRNA therapeutic we are developing with Moderna pursuant to this collaboration, and we have initiated a single ascending dose clinical trial for VX-522 in people with CF. In 2020, we entered into a new collaboration with Moderna aimed at the discovery and development of lipid nanoparticles and mRNAs that can deliver gene-editing therapies to lung cells for the treatment of CF.

- Entrada Therapeutics, Inc. We established a collaboration with Entrada, focused on intracellular EEV therapeutics for DM1, which includes ENTR-701, an EEV-investigational candidate for the treatment of DM1 in late preclinical development.

- Other Arrangements. We have also entered into other arrangements to support our research and development efforts. In 2022, we entered into a collaboration with Verve Therapeutics, Inc. In 2021, we entered into collaborations with Obsidian Therapeutics, Inc. and Mammoth Biosciences, Inc. In 2020, we entered into collaborations with Affinia Therapeutics, Inc and Skyhawk Therapeutics, Inc. In 2019, we entered into collaborations with Ribometrix, Inc. and Kymera Therapeutics.

Out-license Agreements

We have entered into various agreements pursuant to which we have out-licensed rights to certain product candidates to third-party collaborators. Pursuant to these out-license arrangements, our collaborators are responsible for all costs related to the continued development of such product candidates and obtain development and commercialization rights to these product candidates. Depending on the terms of the arrangements, our collaborators may be required to make upfront payments, milestone payments upon the achievement of certain research and development objectives and/or pay royalties on future sales, if any, of commercial products licensed under the agreement.

Cystic Fibrosis Foundation

In 2004, we entered into a collaboration agreement with the Cystic Fibrosis Foundation, as successor in interest to the Cystic Fibrosis Foundation Therapeutics, Inc., to support research and development activities. Pursuant to the collaboration agreement, as amended, we have agreed to pay tiered royalties ranging from single digits to sub-teens on covered compounds first synthesized and/or tested during a research term on or before February 28, 2014, including ivacaftor, lumacaftor and tezacaftor and royalties ranging from low-single digits to mid-single digits on potential net sales of certain compounds first synthesized and/or tested between March 1, 2014 and August 31, 2016, including elexacaftor. We do not have any royalty obligations on compounds first synthesized and tested on or after September 1, 2016. For combination products, such as ORKAMBI, SYMDEKO/SYMKEVI and TRIKAFTA/KAFTRIO, sales are allocated equally to each of the active pharmaceutical ingredients in the combination product.

INTELLECTUAL PROPERTY

Patents and other proprietary rights such as trademarks, trade secrets, and copyrights are critical to our business. We actively seek protection for our products and proprietary information by means of U.S. and foreign patents, trademarks, and copyrights, as appropriate. In addition, we rely upon trade secret protection and contractual arrangements to protect certain of our proprietary information and products.

Patents provide a period of exclusivity that can make it more difficult for competitors to market and use our technology. We own and control patents and pending patent applications that relate to compounds, formulations, treatment of diseases, synthetic routes, intermediates, and other inventions.

To protect our intellectual property, we typically apply for patents several years before a product receives marketing approval. Under current law, a patent expires 20 years from its first effective filing date. Since the drug development process may last for many years, there may be a period of time in which we have an issued patent but not marketing approval to sell the drug. To compensate for patent term lost while a product is in clinical trials and undergoing review for marketing approval, we may be able to apply for patent term extensions or supplementary protection certificates in some countries. In addition to patent protection, we have regulatory exclusivity from U.S. and European regulatory agencies for the active pharmaceutical agents and, where applicable, their approved orphan indications for a certain time period. Regulatory exclusivity runs concurrently with patent exclusivity and provides complementary protection.

We own or hold exclusive and non-exclusive licenses to several hundred patents in the U.S. Upon approval of a New Drug Application ("NDA"), or a supplement thereto, NDA sponsors are required to list with the FDA each patent with claims that cover the applicant's product or a method of using the product. Each of the patents listed by the NDA sponsor is published in the FDA's Orange Book. We have eleven issued U.S. patents listed in the Orange Book that cover the active pharmaceutical ingredients in KALYDECO, its marketed formulations, and/or its approved indication. We have 20 issued U.S. patents listed in the Orange Book that cover the active pharmaceutical ingredients in ORKAMBI, its marketed formulations, and/or its approved indication. We have 21 issued U.S. patents listed in the Orange Book that cover the active pharmaceutical ingredients in SYMDEKO, its marketed formulation, and/or its approved indication. We have 24 issued U.S. patents listed in the Orange Book that cover the active pharmaceutical ingredients in TRIKAFTA, its marketed formulation, and/or its approved indication.

The table below sets forth the year of projected expiration for the basic product patents covering each of our approved products. For products that are combinations of two or more active ingredients, the table lists the projected expiration of the latest expiring patent covering any of the active pharmaceutical ingredients (lumacaftor for ORKAMBI, tezacaftor for SYMDEKO/SYMKEVI and elexacaftor for TRIKAFTA/KAFTRIO). Unless otherwise noted, patent term extensions, supplementary protection certificates, and pediatric exclusivity periods are not reflected in the expiration dates listed in the table below and may extend protection. In some instances, we also own later-expiring patents and applications relating to solid forms, formulations, methods of manufacture, or the use of these drugs in the treatment of particular diseases or conditions. In some cases, however, such patents may not protect our drug from generic competition after the expiration of the basic patent.

Product	Expiration Year of U.S. Basic Product Patent	Expiration Year of European Basic Product Patent
KALYDECO	2027	2025 [1]
ORKAMBI	2030	2026 [2]
SYMDEKO/SYMKEVI	2027	2028 [3]
TRIKAFTA/KAFTRIO	2037	2037

[1] Certain European countries have granted supplementary protection certificates for KALYDECO, which expire in 2027.

[2] Certain European countries have granted supplementary protection certificates for ORKAMBI, which expire in 2030.

[3] Certain European countries have granted supplementary protection certificates for SYMKEVI, which expire in 2033.

In addition to protecting our marketed products, we actively file patent applications in the U.S. and in foreign countries on inventions relating to our pipeline. For example, we also own and/or control U.S. and foreign patents and/or patent applications relating to the following:

- Vanzacaftor, deutivacaftor, and other CF potentiators and correctors and many other related compounds, and the use of those compounds for the treatment CF.
- VX-522 and other mRNA-based approaches for treating CF.
- Exa-cel and other potential gene-editing approaches for treating hemoglobinopathies.
- VX-548 and other compounds being studied for the potential treatment of pain.
- Inaxaplin and other compounds being studied for the potential treatment of AMKD.
- VX-880, VX-264, and other cell-based approaches for treating T1D.
- VX-634 and other compounds being studied for the potential treatment of AATD.
- Other pre-clinical and clinical candidates and the use of such candidates to treat specified diseases.
- The manufacture, pharmaceutical compositions, related solid forms, formulations, dosing regimens, and methods of use of many of the above compounds.

We and CRISPR intend to rely upon a combination of rights, including patent rights, trade secret protection, and

regulatory exclusivities to protect exa-cel. CRISPR has licensed certain rights to a worldwide patent portfolio that covers various aspects of the CRISPR/Cas9 editing platform technology including, for example, compositions of matter and methods of use, including their use in targeting or cutting DNA, from Dr. Emmanuelle Charpentier. In addition to Dr. Charpentier, this patent portfolio has named inventors who assigned their rights to the Regents of the University of California or the University of Vienna, to whom we refer, together with Dr. Charpentier, as the CVC Group. CRISPR has non-exclusive or co-exclusive rights to the patent rights that protect the core CRISPR/Cas9 gene-editing technology. For example, certain third parties, including competitors, have reported obtaining a license to rights in this patent portfolio in certain fields. In addition, patents and patent applications in this patent portfolio are the subject of proceedings in the U.S., Europe, and other jurisdictions, including proceedings in the U.S. Patent and Trademark Office (the "USPTO"), between the CVC Group and, separately, the Broad Institute, Sigma-Aldrich, Co. LLC ("Sigma-Aldrich"), and ToolGen, Inc. ("ToolGen"). To date, both the CVC Group and the Broad Institute have obtained granted patents that purport to cover aspects of CRISPR/Cas9 editing platform technology. The patents and patent applications within the patent portfolios of the CVC Group, the Broad Institute, Sigma-Aldrich and/or ToolGen are, or may in the future be, involved in proceedings similar to interferences or priority disputes in Europe or other foreign jurisdictions. In addition to the patent portfolio licensed from Dr. Charpentier, we own patents and/or patent applications relating to the composition, manufacture, and use of exa-cel.

From time to time, we enter into exclusive and non-exclusive license agreements for proprietary third-party technology used in connection with our research activities. These license agreements typically provide for the payment by us of a license fee but may also include terms providing for milestone payments or royalties for the development and/or commercialization of our drug products arising from the related research.

We cannot be certain that issued patents we own or license will be enforceable or provide adequate protection or that pending patent applications will result in issued patents. The existence of patents does not guarantee our right to practice the patented technology or commercialize the patented product. Litigation, interferences, oppositions, *inter partes* reviews, administrative challenges or other similar types of proceedings may be necessary in some instances to determine the validity and scope of certain patents, regulatory exclusivities or other proprietary rights, and in other instances to determine the validity, scope or non-infringement of intellectual property rights that may be claimed by third parties to be pertinent to the manufacture, use or sale of our products.

MANUFACTURING

As we market and sell our approved products and advance our product candidates through clinical development toward commercialization, we continue to build and maintain our supply chain and quality assurance resources. We rely on internal capabilities and a global network of third parties to manufacture and distribute our product candidates for clinical trials, as well as our products for commercial sale and post-approval clinical trials. In addition to establishing supply chains for each new approved product, we must adapt our supply chain for existing products to include additional formulations that are often required to treat younger patients or to increase scale of production for existing products. We are focused on ensuring the stability of the supply chains for our current products, including TRIKAFTA/KAFTRIO, and for our pipeline programs. In addition, we are focused on identifying and ensuring efficient manufacturing and delivery processes for the cell and genetic therapies we are developing.

We have established our own manufacturing capabilities in Boston, which we use for clinical trial and commercial supplies, including our commercial supply of TRIKAFTA/KAFTRIO. We have established and continue to evaluate additional manufacturing capacity for our current and future products. We expect that we will continue to rely on third parties to meet our commercial supply needs, including for TRIKAFTA/KAFTRIO, and a significant portion of our clinical supply needs for the foreseeable future.

Our supply chain for sourcing raw materials and manufacturing our products, including obtaining all necessary supplies, is a multi-step global endeavor. In general, these raw materials and other necessary supplies are available from multiple sources. Third-party contract manufacturers, including some in China, perform different parts of our manufacturing process. Contract manufacturers may supply us with raw materials, convert these raw materials into drug substance and/or convert the drug substance or product into final dosage form. In addition, third parties assist us with packaging, warehousing, and global distribution of our products.

Establishing and managing this global supply chain for each of our products and product candidates requires a significant financial commitment and the creation and maintenance of numerous third-party contractual relationships. To manufacture

our commercial products, we utilize both continuous manufacturing technology as well as batch manufacturing processes.

We have developed systems and processes to track, monitor, and oversee our and our third-party manufacturers' activities, including a quality assurance program intended to ensure that our third-party manufacturers comply with cGMP. We devote substantial time, resources and effort in the areas of production, quality control, and quality assurance to maintain cGMP compliance. We regularly evaluate the performance of our third-party manufacturers with the objective of confirming their continuing capabilities to meet our needs efficiently and economically. Manufacturing facilities, both foreign and domestic, are subject to inspections by or under the authority of the FDA and other U.S. and foreign government authorities. Although we actively engage with regulatory authorities, the timing of inspections and regulatory approvals for each of these facilities may be delayed for a number of reasons, including the COVID-19 pandemic.

The manufacturing processes for cell and genetic therapies are more complex than those required for small molecule drugs and require different systems, equipment, facilities, and expertise. Additionally, we are unable to utilize a single process for all of our cell and genetic therapies; they must be customized for each program and therapy. We are investing and plan to continue to invest significant resources in expanding and strengthening our manufacturing supplies, infrastructure and capabilities, such as cGMP clinical manufacturing, both independently and through third-party networks, in an effort to develop and commercialize our cell and genetic therapies. We are focused on identifying, evaluating and securing relationships with various third parties globally that will enable us to expand and strengthen such capabilities to support our current and future cell and genetic therapy programs, including exa-cel.

We rely on third-party manufacturers to produce or process cell culture reagents, gene-editing components, such as Cas9 protein and guide RNA molecules, and to generate gene-edited cells to supply exa-cel for clinical trials. If approved, we expect to continue to rely on third-party manufacturers for commercial supply of exa-cel. The manufacturing process for exa-cel involves a number of steps prior to the final infusion of drug product into patients. Following mobilization and collection of blood cells from the patient at the clinical site, cells are transferred to a manufacturing site where HSPCs are purified and CRISPR/Cas9 gene-editing is performed. The edited cellular product, called exa-cel, is frozen and transported back to the clinical site where it is stored prior to infusion into the patient. Each step must be completed successfully, and in a timely manner, requiring coordination between us, clinical sites, third-party manufacturers and shipping vendors. To increase production to commercial levels, we are making significant investments to coordinate manufacturing, testing, and logistics activities at a larger scale across multiple facilities to serve the geographies in which we plan to seek approval for exa-cel. In addition to clinical data establishing the safety and efficacy of exa-cel, approval of exa-cel will require regulatory approval of the processes and facilities used to manufacture and test critical gene-editing components and exa-cel.

COMPETITION

The pharmaceutical industry is characterized by extensive research efforts, rapid technological progress, and intense competition. There are many public and private companies, including pharmaceutical companies and biotechnology companies, engaged in developing products for the indications our drugs are approved to treat and the therapeutic areas we are targeting with our research and development activities. Potential competitors also include academic institutions, government agencies, other public and private research organizations and charitable venture philanthropy organizations that conduct research, seek patent protection and/or establish collaborative arrangements for research, development, manufacturing and commercialization. Mergers and acquisitions in the pharmaceutical, biotechnology and gene therapy industries may result in a larger concentration of resources among a smaller number of our competitors. Some of our competitors may have substantially greater financial, technical, marketing and human resources than we do.

We believe that competition in our industry is based on, among other factors, innovative research, the effective and rapid development of product candidates, the ability to market and obtain reimbursement for products and the ability to establish effective patent protection. We face competition based on the safety and efficacy of our product and product candidates, the timing and scope of regulatory approvals, the availability and cost of supply, marketing and sales capabilities, reimbursement coverage, price, patent protection and other factors. Our competitors may develop or commercialize more effective, safer or more affordable products than we are able to develop or commercialize or obtain more effective patent protection. As a result, our competitors may commercialize products more rapidly or effectively than we do, which would adversely affect our competitive position, the likelihood that our product candidates, if approved, would achieve and maintain market acceptance and our ability to generate meaningful revenues from our products. Future competitive products may render our products, or future products, obsolete or noncompetitive. Another key element of remaining competitive in our industry is recruiting and retaining leading scientific, technical and management personnel to conduct our research activities and advance our

development programs, including with the commercial expertise to effectively market our products.

Cystic Fibrosis

A number of companies are seeking to identify and develop product candidates for the treatment of CF, including CFTR modulators and other therapies intended to address the underlying causes of CF.

AbbVie, Inc. ("AbbVie") has been conducting Phase 2 clinical trials of a potentiator and a corrector and has announced plans to initiate Phase 2 clinical trials of a combination of a potentiator and two correctors in 2023. Proteostasis Therapeutics, Inc. was developing potential CFTR modulator therapies prior to its acquisition by Yumanity Therapeutics, Inc. ("Yumanity"). Following the merger, Yumanity out-licensed the CF program to Fair Therapeutics. Sionna Therapeutics has a CFTR modulator in Phase 1 development.

Other therapeutic approaches include addressing CF utilizing nucleic acid therapies, which are compounds that allow expression of a functional CFTR protein. Nucleic acid therapies are under development by companies such as Arcturus Therapeutics Holdings, Inc., ReCode Therapeutics, Inc., Krystal Biotech, Inc., Spirovant Sciences, Inc. Boehringer Ingelheim International, GmbH, 4D Molecular Therapeutics, Inc and SpliSense, Ltd.

Our success in rapidly developing and commercializing our products may increase the resources that our competitors allocate to the development of these potential treatments for CF. In addition, clinical trials conducted by our competitors could take place simultaneously with our own trials, and may slow down our pace of development if we are unable to recruit sufficient clinical trial subjects. If one or more competing therapies are successfully developed as a treatment for people with CF, our revenues from our current products and/or additional CF products, if then approved, could face significant competitive pressure.

Pipeline

In recent years, we have committed significant research resources to, and made significant investments in, our pipeline of potential new therapies for SCD, TDT, pain, AMKD, T1D, AATD, muscular dystrophies, and other diseases.

Sickle Cell and Beta Thalassemia

There are multiple approved small molecule and biologic treatments for SCD and beta thalassemia, including products from Novartis International AG ("Novartis"), Global Blood Therapeutics, Inc., which was recently acquired by Pfizer, and Bristol Myers Squibb together with Merck & Co. In addition, bluebird bio, Inc. ("bluebird"), obtained FDA approval of its gene therapy, Zynteglo (betibeglogene autotemcel) in August 2022 for the treatment of patients with beta thalassemia who require regular red blood cell transfusions. bluebird is also developing a gene therapy for SCD and previously announced that it expects to file the BLA with the FDA in the first quarter of 2023. In addition, various companies and private academic/medical institutes are developing gene therapy or gene-editing candidates for the treatment of SCD or beta thalassemia utilizing CRISPR technology, lentiviral vectors, zinc finger nuclease technology, or transcription activator-like effector nuclease, gene correction, base or prime editing.

Pain

The acute pain market is dominated by conventional analgesics, including opioids, non-steroidal anti-inflammatory drugs, acetaminophen and local anesthetics, low-cost generics, and reformulations aiming to provide safer, more tolerable or more convenient therapies. Several companies, including Orion Corporation and Luzsana Biotechnology, are pursuing clinical development of novel mechanisms of action for acute and chronic pain indications, including targeting the sodium channels in the NaV family, and there are two selective NaV1.8 inhibitors in clinical trials targeting pain indications.

Additional Programs

Certain of our other product candidates face competition from many pharmaceutical and biotechnology companies. For example, other pharmaceutical and biotechnology companies are actively engaged in the research and development of products for T1D, including strategies to prevent the destruction of beta cells, to protect beta cell function, or to replace missing beta cells. The T1D standard of care of exogenous insulin injections continues to progress toward an artificial pancreas as multiple companies are developing novel insulin formulations, advanced pumps and glucose sensors, and closed loop systems.

There are no approved therapies targeting AMKD. People with chronic kidney disease ("CKD") take angiotensin-converting enzyme inhibitors and angiotensin receptor blockers to treat hypertension; steroids and immunosuppressants to reduce proteinuria; and SGLT2 inhibitors to reduce the risk of CKD progression. These CKD treatments may reduce proteinuria, but do not stop the rapid disease progression seen in AMKD patients. We are aware of two companies that have early programs developing APOL1-targeted assets for patients with AMKD: AstraZeneca in collaboration with Ionis Pharmaceuticals, and Maze Therapeutics.

Several new therapies are under development specifically for the treatment of patients with FSGS. We are not aware of any of these therapies having a mechanism of action targeting those FSGS patients with high-risk variants for APOL1. Travere's sparsentan is currently under regulatory review. Eli Lilly and Company's Janus kinase inhibitor (baricitinib) is being investigated by Duke University in FSGS patients with APOL1-risk variants.

Many other pharmaceutical and biotechnology companies are investing resources for the discovery and development of small molecules and cell and gene therapies to treat the same disease areas for which we are developing therapies in our pipeline. If any of these competitors develop or successfully commercialize products involving therapies competitive with our pipeline therapies, the potential return on our investment in those pipeline therapies could be impacted.

GOVERNMENT REGULATION

Our operations and activities are subject to extensive regulation by numerous government authorities in the U.S., Europe and other countries. In the U.S., Europe and other countries, our products are subject to rigorous regulations governing their testing, manufacture, labeling, storage, record keeping, approval, and advertising and promotion. As a result of these regulations, product development and product approval processes are very expensive and time consuming. The regulatory requirements applicable to drug and biologic development, approval, and marketing are subject to change. In addition, regulations and administrative guidance often are revised or reinterpreted by the agencies in ways that may significantly affect our business and our products. It is impossible to predict whether legislative changes will be enacted, or FDA or comparable ex-U.S. regulations, guidance or interpretations will change.

United States Government Regulation

New Drug Application and Biologics License Application Approval Processes

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

- completion of preclinical laboratory tests, animal studies and formulation studies conducted according to Good Laboratory Practices ("GLP"), and other applicable regulations;
- submission to the FDA of an IND, which must become effective before clinical trials in the U.S. may begin;
- performance of adequate and well-controlled clinical trials according to Good Clinical Practices ("GCP"), and other clinical trial-related regulations to establish the safety and efficacy of the proposed drug for its intended use;
- submission to the FDA of an NDA or a BLA;
- satisfactory completion of a pre-approval FDA inspection of the manufacturing facility or facilities at which the product will be produced to assess compliance with cGMP; and
- FDA review and approval of the NDA or BLA.

Once a drug or biologic is identified for development, it enters the preclinical testing stage. Preclinical tests include laboratory evaluations of product chemistry, toxicity and formulation, as well as animal pharmacology and toxicology studies. An IND sponsor must submit the results of the preclinical tests, together with manufacturing information and analytical data, to the FDA as part of the IND, which seeks FDA approval to test the drug or biologic in humans. Preclinical or nonclinical testing typically continues even after the IND is submitted.

If the FDA accepts the IND, the drug or biologic can then be studied in human clinical trials to determine if the product candidate is safe and effective. Clinical trials involve three separate phases that often overlap, can take many years and are

expensive. These three phases, which are subject to considerable regulation, are as follows:

- *Phase 1.* The drug or biologic initially is introduced into a limited number of healthy human subjects or patients with the target disease or condition and tested for safety, dosage tolerance, absorption, metabolism, distribution and elimination. In the case of some drugs or biologics for severe or life-threatening diseases, such as cancer, especially when the drug or biologic 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 next initiated in a limited patient population with the specified disease or condition the drug or biologic is intended to treat to identify possible adverse effects and safety risks, to preliminarily evaluate the efficacy of the drug or biologic candidate for the disease or condition it is intended to treat 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 trial sites. These clinical trials are intended to establish the overall risk-benefit ratio of the drug or biologic and provide an adequate basis for regulatory approval and product labeling.

It is possible that Phase 1, Phase 2 and Phase 3 testing may not be completed successfully within any specified period, if at all. The FDA or the sponsor may, at any time during the initial 30-day IND review period or while clinical trials are ongoing under the IND, impose a partial or complete clinical hold or suspend a clinical trial at any time for a variety of reasons, including a finding that the healthy volunteers or patients are being exposed to an unacceptable health risk. Progress reports detailing the results of the clinical trials must be submitted at least annually to the FDA and more frequently in other situations, and the occurrence of serious adverse events must also be reported. Information about certain clinical trials must be submitted within specific timeframes to the National Institutes of Health for public dissemination on the *www.clinicaltrials.gov* website.

Post-approval trials, sometimes referred to as Phase 4 clinical trials, may be conducted after initial marketing approval. These trials are used to gain additional experience from the treatment of patients in the intended therapeutic indication and are commonly intended to generate additional safety data regarding use of the product in a clinical setting. In certain instances, the FDA may mandate the performance of Phase 4 clinical trials as a condition of approval of an NDA or BLA.

The results of drug or biologic development, preclinical studies and clinical trials, along with descriptions of the manufacturing process, analytical tests conducted on the chemistry of the drug or biologic, proposed labeling and other relevant information are submitted to the FDA as part of an NDA or BLA requesting approval to market the drug or biologic. The FDA reviews each NDA or BLA submitted to ensure that it is sufficiently complete for substantive review before it accepts it for filing. It may request additional information rather than accept an NDA or BLA for filing.

Once the submission is accepted for filing, the FDA begins an in-depth review. The FDA reviews an NDA or BLA to determine, among other things, whether a drug or biologic is safe and effective for its intended use and whether its manufacturing is cGMP-compliant to assure and preserve the drug or biologic's identity, strength, quality and purity. The FDA may refer the NDA or BLA to an advisory committee for review and recommendation as to whether the NDA or BLA 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. Before approving an NDA or BLA, the FDA will inspect the facility or facilities where the drug or biologic is manufactured and tested. Additionally, before approving an NDA or BLA, the FDA may inspect one or more clinical trial sites to assure compliance with GCP requirements.

The FDA may require, as a condition of approval, restricted distribution and use, enhanced labeling, special packaging or labeling, expedited reporting of certain adverse events, pre-approval of promotional materials, restrictions on direct-to-consumer advertising or commitments to conduct additional research post-approval. The FDA will issue a complete response letter if the agency decides not to approve the NDA or BLA in its present form.

Expedited Review and Approval

The FDA has developed a number of distinct approaches to make new drugs or biologics available as rapidly as possible in cases where there is no available treatment or there are advantages over existing treatments.

The FDA may grant "accelerated approval" to products that have been studied for their safety and effectiveness in treating serious illnesses and that provide meaningful therapeutic benefit to patients over existing treatments. For accelerated

approval, the product must have an effect on a surrogate endpoint or an intermediate clinical endpoint that is considered reasonably likely to predict the clinical benefit of a drug, such as an effect on irreversible morbidity and mortality. When approval is based on surrogate endpoints or clinical endpoints other than survival or morbidity, the sponsor will be required to conduct additional post-approval clinical studies to verify and describe the clinical benefit. These studies are known as "confirmatory trials." Approval of a drug may be withdrawn, or the labeled indication of the drug changed if these trials fail to verify clinical benefit or do not demonstrate sufficient clinical benefit to justify the risks associated with the drug or biologic.

The FDA may grant "fast track" status to products that treat serious diseases or conditions and demonstrate the potential to address an unmet medical need. Fast track is a process designed to facilitate the development and expedite the review of such products by providing, among other things, more frequent meetings with the FDA to discuss the product's development plan and rolling review, which allows submission of individually completed sections of an NDA or BLA for FDA review before the entire submission is completed. Fast track status does not ensure that a product will be developed more quickly or receive FDA approval.

"Breakthrough Therapy" designation is a process designed to expedite the development and review of drugs or biologics that are intended to treat a serious condition and preliminary clinical evidence indicates that the drug or biologic may demonstrate substantial improvement over available therapy on one or more clinically significant endpoints. Breakthrough Therapy designation provides all of the benefits of fast-track designation in addition to robust FDA-sponsor interaction and communication to help to identify the most efficient and expeditious path for clinical development while minimizing the number of patients placed in ineffective control regimens.

"Regenerative Medicine Advanced Therapy," ("RMAT") designation is a process created by the 21st Century Cures Act in December 2016. A product is eligible for RMAT designation if it is a regenerative medicine therapy that is intended to treat, modify, reverse or cure a serious disease or condition, and if preliminary clinical evidence indicates that the product has the potential to address unmet medical needs for such disease or condition. The benefits of RMAT designation include the benefits available to breakthrough therapies, including potential eligibility for priority review and accelerated approval based on surrogate or intermediate endpoints.

The FDA may grant "priority review" status to a product that, if approved, would provide significant improvement in the safety or effectiveness of the treatment, diagnosis, or prevention of serious conditions. Priority review is intended to reduce the time it takes for the FDA to review an NDA or BLA, with the goal to take action on the application within six months from when the application is filed, compared to ten months for a standard review.

Manufacturing Quality Control

Among the conditions for NDA or BLA approval is the requirement that the prospective manufacturer's quality control and manufacturing procedures continually conform with cGMP. Manufacturers must devote substantial time, money and effort in the areas of production, quality control, and quality assurance to maintain cGMP compliance. Material changes in manufacturing equipment, location, or process, may result in additional regulatory review and approval. The FDA, and other regulatory agencies, conduct periodic visits to inspect equipment, facilities, and processes following the initial approval of a product. If a manufacturing facility is not in substantial compliance with the applicable regulations and requirements imposed when the product was approved, regulatory or judicial enforcement action may be initiated, which may include a warning letter, suspension of manufacturing, product seizure, or an injunction against shipment of products from the facility and/or recall of products previously shipped. We rely, and expect to continue to rely, on third parties for the production of our products. Future FDA, state, and foreign inspections may identify compliance issues at the facilities of our contract manufacturers that may disrupt manufacture or distribution of our products or require substantial resources to correct.

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 reaches the market. Later discovery of previously unknown problems with a product may result in restrictions on the product or complete withdrawal of the product from the market. In addition, the sponsor of an approved drug in the U.S. may not promote that drug for unapproved, or off-label, uses, although a physician may prescribe a drug for an off-label use in accordance with the practice of medicine. The FDA and other agencies actively enforce the laws and regulations prohibiting the promotion of off-label uses. Further, after approval, some types of changes to the approved product, such as adding new indications, manufacturing changes and additional labeling claims, are subject to

further FDA review and approval. In addition, the FDA may require testing, including Phase 4 trials, and surveillance programs to monitor the effect of approved products that have been commercialized, and the FDA has the power to prevent or limit further marketing of a product based on the results of these post-marketing programs.

Products we manufacture or distribute 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;
- providing the FDA with updated safety and efficacy information;
- drug sampling and distribution requirements;
- notifying the FDA and gaining its approval of specified manufacturing or labeling changes;
- complying with certain electronic records and signature requirements; and
- complying with FDA promotion and advertising requirements.

Failure to comply with the applicable U.S. requirements at any time during the drug or biologic development process, approval process or after approval, may subject us or our collaborators to administrative or judicial sanctions, any of which could have a material adverse effect on us. These sanctions could include:

- restrictions on marketing or manufacturing of the product;
- safety alerts, Dear Healthcare Provider letters, press releases, or other communications containing warnings or other safety information about the product;
- refusal to approve or delay in review of pending applications;
- withdrawal of an approval or the implementation of limitations on a previously approved indication for use;
- imposition of a clinical hold, a risk evaluation and mitigation strategy ("REMS") or other safety-related limitations;
- warning letters or "untitled letters";
- product seizures, recalls, or detentions, or refusal to permit the import or export of products;
- total or partial suspension of production or distribution;
- consent decrees, corporate integrity agreements, debarment or exclusion from federal healthcare programs; or
- injunctions, fines, disgorgement, refusals of government contracts, or civil or criminal penalties.

United States Patent Term Restoration and Regulatory Exclusivity

Upon approval, products may be entitled to certain kinds of exclusivity under applicable intellectual property and regulatory regimes. The Drug Price Competition and Patent Term Restoration Act of 1984 (commonly known as 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. The length of the patent extension is roughly based on 50 percent of the period of time from the filing of an IND for a compound to the submission of the NDA for such compound, plus 100 percent of the time period from NDA submission to regulatory approval. The extension, however, cannot exceed five years and the patent term remaining after regulatory approval cannot exceed 14 years.

If the FDA approves a drug product that contains a new chemical entity not previously approved, the product is typically entitled to five years of non-patent regulatory exclusivity. Other products may be entitled to three years of exclusivity if approval was based on the FDA's reliance on new clinical studies essential to approval submitted by the NDA applicant.

Biologics are also entitled to exclusivity under the Biologics Price Competition and Innovation Act (the "BPCIA"),

which was passed as Title VII to the ACA. The law provides a pathway for approval of products that are biosimilar to or interchangeable with an FDA-licensed reference biological product. Under the BPCIA, a reference biological product is granted 12 years of data exclusivity, the period of time during which an innovator's clinical data cannot be used by other companies, from the time of first licensure of the product, and an application for a biosimilar product may not be submitted to the FDA until four years following the date that the reference product was first licensed by the FDA. In addition, the approval of a biosimilar product may not be made effective by the FDA until 12 years from the date on which the reference product was first licensed. The BPCIA also created certain exclusivity periods for biosimilars approved as interchangeable products. At this juncture, it is unclear whether products deemed "interchangeable" by the FDA will, in fact, be readily substituted by pharmacies, which are governed by state pharmacy law. Biologics are also eligible for orphan drug exclusivity, as discussed below. The law also includes an extensive process for the innovator biologic and biosimilar manufacturer to litigate patent infringement, validity, and enforceability prior to the approval of the biosimilar. There have been ongoing federal legislative and administrative efforts as well as judicial challenges seeking to repeal, modify or invalidate some or all of the provisions of the ACA. While none of those efforts have focused on changes to the provisions of the ACA related to the biosimilar regulatory framework, if the ACA is repealed, substantially modified, or invalidated, it is unclear what, if any, impact such action would have on biosimilar regulation.

If the NDA or BLA applicant studies the product for use by children, the FDA may grant pediatric exclusivity, which extends by 180 days each existing exclusivity (patent and regulatory) related to the product.

Orphan Drug Designation and Exclusivity

Under the Orphan Drug Act, the FDA may grant orphan drug designation to drugs or biologics intended to treat a rare disease or condition, which is generally a disease or condition that affects fewer than 200,000 people in the U.S.

If a drug or biologic that has orphan drug designation subsequently receives the first FDA approval for that drug or biologic for the disease for which it has such designation, the product is entitled to orphan drug exclusivity, which means that the FDA may not approve any other applications to market the same drug for the same disease or condition for seven years following marketing approval, except in certain very limited circumstances, such as if the later product is shown to be clinically superior to the orphan product. Orphan drug exclusivity, however, also could block the approval of our products for seven years if a competitor first obtains approval of the same drug, as defined by the FDA, for the same disease or condition for which we were seeking approval. KALYDECO, ORKAMBI, SYMDEKO, and TRIKAFTA have been granted orphan drug exclusivity by the FDA.

We may pursue orphan drug designation for certain of our future product candidates. Even if we obtain orphan drug designation for a product candidate, we may not be the first to obtain marketing approval for the product candidate for any particular orphan indication due to the uncertainties associated with developing novel therapies. Further, even if we obtain orphan drug exclusivity for a product candidate, that exclusivity may not effectively protect the product from competition because orphan drug exclusivity does not prevent different drugs from being approved for the same condition. Moreover, orphan drug exclusivity may not prevent the approval of another sponsor's product that is considered to be the same drug for a different disease or condition, even where such product could be used off-label for the indication that is protected by orphan drug exclusivity. Even after an orphan drug is approved, regulators may subsequently approve the same drug made by another manufacturer for the same condition if the regulator concludes that the later drug is safer, more effective, or makes a major contribution to patient care. Orphan drug designation neither shortens the development time or regulatory review time of a drug or biologic nor gives the drug or biologic any advantage in the regulatory review or approval process.

Foreign Regulation

We conduct clinical trials and market our products in numerous jurisdictions outside the U.S. Most of these jurisdictions have clinical trial, product approval and post-approval regulatory processes that are similar in principle to those in the U.S. Thus, whether or not we obtain FDA approval for a product candidate, we must obtain approval by the comparable regulatory authorities of foreign countries or economic areas, such as the E.U., before we can commence clinical trials or 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 the E.U. regulatory system, a company may submit marketing authorization applications either under a centralized or decentralized procedure. The centralized procedure, which is compulsory for orphan medicines, medicines produced by

biotechnology, and those medicines intended to treat AIDS, cancer, neurodegenerative disorders, or diabetes, and optional for those medicines that are highly innovative, provides for the grant of a single marketing authorization that is valid for all E.U. member states. In addition to the centralized procedure, the E.U. also has a nationalized procedure, which requires a separate application to and approval determination by each country; a decentralized procedure, whereby applicants submit identical applications to several countries and receive simultaneous approval; and a mutual recognition procedure, where applicants submit an application to one country for review and other countries may accept or reject the initial decision.

Additionally, our European headquarters and European research facility are located in the U.K. Despite the U.K. formally withdrawing from the E.U. on January 31, 2020, a number of E.U. regulations were retained in U.K. law. It is intended that these retained provisions be removed from or replaced in U.K. law at the end of 2023, which may increase regulatory divergence between the U.K. and the E.U. Given the current uncertainty as to what changes may be incorporated into U.K. law, it is unclear if any such changes could adversely affect our business, financial condition, and operating results.

Other Regulations

Pharmaceutical companies are also subject to various laws pertaining to healthcare "fraud and abuse," including the federal Anti-Kickback Statute ("AKS"), the False Claims Act ("FCA"), and other state and federal laws and regulations. In the U.S., the Anti-Kickback Statute generally makes it illegal to knowingly and willfully solicit, offer, receive or pay any remuneration in return for or to induce the referral of business, including the purchase or prescription of a particular drug that is reimbursed by a state or federal health care program. The FCA prohibits knowingly and willingly presenting, or causing to be presented for payment to third-party payors (including Medicare and Medicaid), any claims for reimbursed drugs or services that are false or fraudulent, claims for items or services not provided as claimed or claims for medically unnecessary items or services. Violations of fraud and abuse laws may be punishable by criminal and/or civil sanctions, including fines and civil monetary penalties, as well as by the possibility of exclusion from federal healthcare programs (including Medicare and Medicaid). Liability under the FCA may also arise when a violation of certain laws or regulations related to the underlying products (e.g., violations regarding improper promotional activity, manufacturing regulations, or unlawful payments) contributes to the submission of a false claim. If we were subject to allegations concerning, or convicted of violating, these laws, our business could be harmed.

Laws and regulations also have been enacted by the federal government and various states to regulate the sales and marketing practices of pharmaceutical manufacturers. The laws and regulations generally limit financial interactions between manufacturers and health care providers, require manufacturers to adopt certain compliance standards or require disclosure to the government and public of such interactions. The laws include U.S. federal and state "sunshine" provisions. The federal sunshine provisions apply to pharmaceutical manufacturers with products reimbursed under certain government programs and require those manufacturers to disclose annually to the federal government (for re-disclosure to the public) certain payments and other transfers of value made to physicians and teaching hospitals and, beginning with disclosures in 2022, to certain non-physician practitioners. State laws may also require disclosure of pharmaceutical pricing information and marketing expenditures. Many of these laws and regulations contain requirements that are subject to interpretation. Outside the U.S., other countries have implemented requirements for disclosure of financial interactions with healthcare providers and additional countries may consider or implement such laws.

We are subject to various federal and foreign laws that govern our international business practices with respect to payments to government officials. Those laws include the U.S. Foreign Corrupt Practices Act ("FCPA"), which prohibits U.S. companies and their representatives from paying, offering to pay, promising, or authorizing the payment of anything of value to any foreign government official, government staff member, political party, or political candidate for the purpose of obtaining or retaining business or to otherwise obtain favorable treatment or influence a person working in an official capacity. In many countries, the health care professionals we regularly interact with may meet the FCPA's definition of a foreign government official. We are also subject to U.K. Bribery Act 2010 ("the Bribery Act"), which proscribes giving and receiving bribes in the public and private sectors, bribing a foreign public official, and failing to have adequate procedures to prevent employees and other agents from giving bribes. U.S. companies that conduct business in the U.K. generally will be subject to the Bribery Act.

We are subject to federal laws, including the Medicaid Drug Rebate Program, the 340 program, and the FSS pricing program, that require pharmaceutical manufacturers to report certain calculated product prices to the government or provide certain discounts or rebates to government authorities or private entities, often as a condition of reimbursement under government healthcare programs.

Our collection and use of personal data as part of our business activities is subject to various privacy and data security laws and regulations, including oversight by various regulatory or other governmental bodies, in the U.S., E.U., U.K., Canada, Australia, Brazil and other jurisdictions. Such laws and regulations have the potential to affect our business materially, continue to evolve and increasingly are being enforced.

Our present and future business has been and will continue to be subject to various other laws and regulations. Various laws, regulations, and recommendations relating to safe working conditions, laboratory practices, the experimental use of animals, and the purchase, storage, movement, import, export and use and disposal of hazardous or potentially hazardous substances are or may be applicable to our activities. In addition, as we expand our pipeline and contemplate different approaches that may incorporate the use of medical devices, such approaches may necessitate compliance with regulatory laws applicable to medical devices, including those governing the testing, manufacture, approval, distribution, and marketing of medical devices. Furthermore, the extent of government regulation, which might result from future legislation or administrative action, cannot accurately be predicted.

We have a global corporate compliance program designed to actively identify, prevent, and mitigate healthcare fraud and abuse risk through, among other things, the implementation of compliance policies and systems and through the promotion of a culture of compliance. We will continue to devote substantial resources to enhance and expand our corporate compliance program as necessary to help us manage and mitigate our evolving compliance risk environment as our business grows and expands globally. Even with these measures, however, we cannot guarantee compliance with the various complex laws and regulations to which we are subject now or in the future.

EMPLOYEES AND HUMAN CAPITAL MANAGEMENT

As of December 31, 2022, we had approximately 4,800 employees. Of these employees, approximately 3,900 were based in the U.S. and approximately 900 were based outside the U.S. None of our U.S. employees are covered by a collective bargaining agreement. A small number of employees outside the U.S. are covered by such agreements due to local law or industry requirements. We consider our relations with our employees to be good. We face intense competition for our personnel from our competitors and other companies throughout our industry and from universities and research institutions. Over the last several years, the challenges in recruiting and retaining employees across the biotechnology industry have increased substantially due to current industry job market dynamics.

We rely on skilled, experienced, and innovative employees to conduct the operations of our company. The biotechnology industry is very competitive, and recruiting and retaining such employees is important to the continued success of our business. We are committed to building an outstanding, committed, and passionate team at Vertex, and we focus on a culture that values inclusion, diversity, and equity. We believe that each employee brings unique perspectives and strengths, and by embracing these strengths, we can do our best work for patients. We focus on recruiting, retaining, and developing employees from a diverse range of backgrounds to conduct our research, development, commercial, and other business activities.

Our commitment to inclusion, diversity, and equity begins with our executive management team: four of the ten members are women and/or from underrepresented ethnic and racial groups. On our Board of Directors, four of our eleven members are women and five members are from underrepresented ethnic and racial groups. As of December 31, 2022, women represented 54% of our global workforce and 39% of our leadership (VP and above). As of December 31, 2022, 40% of our U.S. workforce, and 20% of our U.S. leadership (VP and above), were from underrepresented ethnic and racial groups.

Our inclusion, diversity, and equity strategy and efforts are important to our culture. Our initiatives include learning, resources, and forums that promote inclusion, diversity, and equity in our workplaces; efforts to develop a diverse pipeline of talent from early career through leadership; four global employee resource networks that promote connectivity and collaboration across levels and functions, and engage colleagues in personal and professional development opportunities, including mentoring, community outreach, and cultural awareness activities; and investments to support efforts to address racism and social injustice.

To promote our employees' continued well-being and development, we offer a variety of inclusive benefits and opportunities. We offer comprehensive work-life benefits, including health, dental, and income protection, such as life insurance and retirement savings programs and we enhanced and expanded those employee benefits in response to the COVID-19 pandemic. For example, we increased company-wide personal time off, provided resources to enable employees to work from home, continued to promote and expand mental wellness tools, and enhanced child/elder care benefits for all

employees. We continually review and augment our programs to include benefits such as expanded parental bonding and increased support for family planning. We have also expanded our gender affirming benefits. Our management continues to assess and respond to the evolving needs of our workforce throughout the pandemic.

In addition, we provide our employees with career development and advancement opportunities, including job rotations, mentoring, and managerial training. We are committed to identifying and developing our next generation of leaders and have developed programs focused on talent and succession for critical roles in our organization.

OTHER MATTERS

Financial Information and Significant Customers

We operate in one segment, pharmaceuticals. Financial information about our revenue by product and significant customers is set forth in Note R, "Segment Information," to our consolidated financial statements included in this Annual Report on Form 10-K.

Information Available on the Internet

Our internet address is *www.vrtx.com.* Our annual reports on Form 10-K, quarterly reports on Form 10-Q and current reports on Form 8-K, and all amendments to those reports, are available to you free of charge through the "Investors-SEC Filings" section of our website as soon as reasonably practicable after those materials have been electronically filed with, or furnished to, the Securities and Exchange Commission.

Corporate Information

Vertex was incorporated in Massachusetts in 1989, and our principal executive offices are located at 50 Northern Avenue Boston, Massachusetts 02210.

INFORMATION ABOUT OUR EXECUTIVE OFFICERS

The names, ages and positions held by our executive officers are as follows:

Name	Age	Position
Reshma Kewalramani, M.D.	50	Chief Executive Officer and President
Jeffrey M. Leiden, M.D., Ph.D.	67	Executive Chairman
David Altshuler, M.D., Ph.D.	58	Executive Vice President, Global Research and Chief Scientific Officer
Stuart A. Arbuckle	57	Executive Vice President and Chief Operating Officer
Jonathan Biller, J.D.	59	Executive Vice President, Chief Legal Officer
Carmen Bozic, M.D.	60	Executive Vice President, Global Medicines Development and Medical Affairs, and Chief Medical Officer
Amit K. Sachdev, J.D.	55	Executive Vice President, Chief Patient Officer
Bastiano Sanna, Ph.D.	48	Executive Vice President, Chief of Cell and Genetic Therapies
Ourania "Nia" Tatsis, Ph.D.	53	Executive Vice President and Chief Regulatory and Quality Officer
Charles F. Wagner, Jr.	54	Executive Vice President and Chief Financial Officer
Kristen C. Ambrose	46	Senior Vice President and Chief Accounting Officer

Dr. Kewalramani has been our Chief Executive Officer and President since April 2020 and a member of our Board of Directors since February 2020. Dr. Kewalramani was our Executive Vice President and Chief Medical Officer from April 2018 through April 2020. She was our Senior Vice President, Late Development from February 2017 until April 2018. From August 2004 to January 2017, she served in roles of increasing responsibility at Amgen Inc., most recently as Vice President and Head of U.S. Medical Organization. From 2014 through 2019, Dr. Kewalramani was the industry representative to the FDA's Endocrine and Metabolic Drug Advisory Committee. Dr. Kewalramani also has served on the board of Ginkgo Bioworks since September 2021. She completed her internship and residency in Internal Medicine at the Massachusetts General Hospital and her fellowship in Nephrology at the Massachusetts General Hospital and Brigham and Women's

Hospital combined program. Dr. Kewalramani holds a B.A. from Boston University and an M.D. from Boston University School of Medicine. Dr. Kewalramani also completed the General Management Program at Harvard Business School and is an alumnus of the school.

Dr. Leiden is our Executive Chairman, a position he has held since in April 2020. He was our Chief Executive Officer and President from 2012 through March 2020. He has been a member of our Board of Directors since July 2009, the Chairman of our Board of Directors since May 2012, and served as our lead independent director from October 2010 through December 2011. Dr. Leiden was a Managing Director at Clarus Ventures, a life sciences venture capital firm, from 2006 through January 2012. Dr. Leiden was President and Chief Operating Officer of Abbott Laboratories, Pharmaceuticals Products Group, and a member of the Board of Directors of Abbott Laboratories from 2001 to 2006. From 1987 to 2000, Dr. Leiden held several academic appointments, including the Rawson Professor of Medicine and Pathology and Chief of Cardiology and Director of the Cardiovascular Research Institute at the University of Chicago, the Elkan R. Blout Professor of Biological Sciences at the Harvard School of Public Health, and Professor of Medicine at Harvard Medical School. He is an elected member of both the American Academy of Arts and Sciences and the Institute of Medicine of the National Academy of Sciences. Dr. Leiden is a director of the Massachusetts Mutual Life Insurance Company, an insurance company. Dr. Leiden was a director and the non-executive Vice Chairman of the board of Shire plc, a specialty biopharmaceutical company, from 2006 to January 2012, a director of Quest Diagnostics, a publicly traded medical diagnostics company, from December 2014 to May 2019, and the Chairman of Revolution Healthcare Acquisition Corp., a special purpose acquisition corporation, from April 2021 to December 2022. Dr. Leiden received his M.D., Ph.D. and B.A. degrees from the University of Chicago.

Dr. Altshuler has been our Executive Vice President, Global Research and Chief Scientific Officer since January 2015 and was a member of our Board of Directors from May 2012 through December 2014. Dr. Altshuler was one of four founding members of the Broad Institute, a research collaboration of Harvard University and the Massachusetts Institute of Technology, The Whitehead Institute and the Harvard Hospitals. He served as the Director of the Institute's Program in Medical and Population Genetics from 2003 through December 2014 and as the Institute's Deputy Director and Chief Academic Officer from 2009 through December 2014. Dr. Altshuler joined the faculty at Harvard Medical School and the Massachusetts General Hospital in 2000 and held the academic rank of Professor of Genetics and Medicine from 2008 through December 2014. He served as Adjunct Professor of Biology at MIT from 2012 through December 2014. Dr. Altshuler earned a B.S. from MIT, a Ph.D. from Harvard University and an M.D. from Harvard Medical School. Dr. Altshuler completed his clinical training in Internal Medicine, and in Endocrinology, Diabetes and Metabolism, at the Massachusetts General Hospital.

Mr. Arbuckle is our Executive Vice President, Chief Operating Officer, a position he has held since July 2021. Previously, Mr. Arbuckle served as Executive Vice President, Chief Commercial and Operations Officer from March 2021 to July 2021, and as our Executive Vice President, Chief Commercial Officer from September 2012 to February 2021. Prior to joining us, Mr. Arbuckle held multiple commercial leadership roles at Amgen, Inc. from July 2004 through August 2012. Mr. Arbuckle has worked in the biopharmaceuticals industry since 1986, including more than 15 years at GlaxoSmithKline plc, where he held sales and marketing roles of increasing responsibility for medicines aimed at treating respiratory, metabolic, musculoskeletal, cardiovascular and other diseases. He served as a member of the Board of Directors of Cerulean Pharma, Inc. from June 2015 through July 2017 and has served as a member of the Board of Directors of ImmunoGen, Inc. since January 2018 and of Rhythm Pharmaceuticals Inc. since July 2019. Mr. Arbuckle holds a BSc in Pharmacology and Physiology from the University of Leeds.

Mr. Biller has been our Executive Vice President, Chief Legal Officer since September 2022. From November 2019 until he joined Vertex, Mr. Biller served in several executive roles at Agios Pharmaceuticals, Inc., including Chief Legal Officer and, most recently, Chief Financial Officer and Head of Corporate Affairs. Prior to Agios, he served as Executive Vice President, General Counsel at Celgene from July 2018 to November 2019, where he was responsible for their global legal function, and served as Senior Vice President, Tax and Treasury from 2011 to June 2018. Prior to Celgene, Mr. Biller was General Counsel, Chief Tax Officer and Secretary at Bunge Limited, a global publicly traded agriculture and food company. Earlier in his career he held various leadership roles at Alcon, Inc. and was a partner at Hopkins & Sutter and Foley & Lardner. Mr. Biller holds a B.A. from Brown University and a J.D. from Yale Law School.

Dr. Bozic is our Executive Vice President, Global Medicines Development and Medical Affairs, a position she has held since October 2019, and she has been our Chief Medical Officer since April 2020. She was our Senior Vice President and Head of Global Clinical Development from May 2019 to October 2019. Prior to joining Vertex, Dr. Bozic spent more than 20

years at Biogen Inc., a biotechnology company focused on neurological diseases, most recently as Senior Vice President of Global Development and Portfolio Transformation from 2015 to May 2019 and as Senior Vice President of Clinical and Safety Sciences from 2013 to 2015. Dr. Bozic has served as the industry representative to the FDA's Risk Communication Advisory Committee, and was a member of PhRMA's Clinical and Preclinical Development Committee and the Board of Managers at BioMotiv. She is a member of the Clinical Advisory Board at Akili Interactive. She received her M.D., C.M., completed her residency, and was Chief Resident in Internal Medicine at McGill University. She completed her fellowship in Pulmonary and Critical Care Medicine at Brigham and Women's Hospital, and was an Associate Physician at Beth Israel Deaconess Medical Center and Harvard Medical School before joining the biopharmaceutical industry.

Mr. Sachdev is our Executive Vice President, Chief Patient Officer, a role he has held since October 2019. In addition, Mr. Sachdev has served in the role of Chief of Staff to the CEO since April 2020. He served as our Executive Vice President and Chief Regulatory Officer from January 2017 until September 2019, and as our Executive Vice President, Policy, Access and Value from October 2014 through December 2016. In 2010, he established our first international commercial operations in Canada. In 2007, he joined us as a Senior Vice President, and has led our government affairs and public policy activities, as well as our patient advocacy programs. Prior to joining us, Mr. Sachdev served as Executive Vice President, Health, of the Biotechnology Industry Organization (BIO) and was the Deputy Commissioner for Policy at the FDA, where he also served in several other senior positions. Prior to the FDA, Mr. Sachdev served as Majority Counsel to the Committee on Energy and Commerce in the U.S. House of Representatives and practiced law at the American Chemistry Council, and subsequently at the law firm of Ropes & Gray LLP. He has served as a member of the Board of Directors of Eiger BioPharmaceuticals since April 2019. Mr. Sachdev holds a B.S from Carnegie Mellon University and a J.D. from Emory University School of Law.

Dr. Sanna is our Executive Vice President, Chief of Cell and Genetic Therapies, a position he has held since February 2020. From October 2019 to February 2020, he was President of Semma Therapeutics, Inc., a private biotechnology company that Vertex acquired in October 2019. Prior to the acquisition, Dr. Sanna was the Chief Executive Officer and President of Semma from May 2018 until October 2019. Dr. Sanna was Chief Operating Officer at Magenta Therapeutics from May 2016 through April 2018. He served on the leadership team of the Novartis Cell and Gene Therapy Unit as the Global Program Head of Stem Cell Transplant and early programs from 2014 through 2016. Dr. Sanna served as Global Head of Strategic Planning and Portfolio Management at the Novartis Institutes for BioMedical Research from 2010 through 2014. Dr. Sanna has served as a member of the Board of Directors of Adicet Bio, Inc., a biotechnology company since December 2020. Dr. Sanna received a Ph.D. in Biotechnology from the University of Sassari.

Dr. Tatsis is our Executive Vice President, Chief Regulatory and Quality Officer, a position she has held since August 2020. Previously, she was our Senior Vice President and Chief Regulatory Officer from October 2019 to August 2020, and our Senior Vice President, Global Regulatory Affairs from September 2017 to October 2019. Prior to joining Vertex, Dr. Tatsis held positions of increasing responsibility at several pharmaceutical companies, including Sanofi, Stemnion, Pfizer, and Wyeth. Most recently, from 2014 to 2017, she was Vice President, Head of Global Regulatory Affairs, at the Sanofi Genzyme Business Unit focused on Inflammation/Immunology, Rare Disease, Multiple Sclerosis, Ophthalmology, Neurology, and Oncology/Immuno-Oncology. Dr. Tatsis also worked as an associate staff scientist and research fellow in Immunology and Vaccine Development at the Wistar Institute and completed a post-doctoral research fellowship in Immunology at Thomas Jefferson University. She received her Ph.D. in Cell and Molecular Biology from the University of Vermont and holds a B.S. in Biology from Temple University.

Mr. Wagner is our Executive Vice President and Chief Financial Officer, a position he has held since April 2019. Prior to joining Vertex, Mr. Wagner was Chief Financial Officer and Executive Vice President, Finance, of Ortho Clinical Diagnostics, a Carlyle Group portfolio company, from June 2015 to March 2019. In that role, he led the finance, accounting, tax, treasury, global financial systems, lender relations, and acquisitions and divestiture groups, and also had shared leadership for several enterprise-wide projects. From July 2012 to June 2015, Mr. Wagner served as Executive Vice President, Chief Financial Officer of Bruker Corporation, a scientific instruments manufacturer. Prior to that, Mr. Wagner served as Chief Financial Officer for Progress Software Corporation, a provider of enterprise software, and Millipore Corporation, a global provider of products and services in the life science tools market. Mr. Wagner served as a director and chairman of the Audit Committee of Good Start Genetics, Inc., a molecular diagnostics company, from April 2014 to August 2017 and served as a director and member of the Audit Committee of Bruker Corporation from August 2010 to June 2012. Mr. Wagner holds a B.S. in Accounting from Boston College and a M.B.A from Harvard Business School.

Ms. Ambrose is our Senior Vice President, Chief Accounting Officer, a position she has held since May 2021. Ms. Ambrose previously served as our Senior Vice President, Accounting, Tax, Treasury, Strategic Sourcing and Corporate

Services since March 2021. From February 2003 until she joined Vertex, Ms. Ambrose held roles of increasing responsibility at Boston Scientific Corporation, a medical device company, most recently as Vice President of Finance and Controller of the Global Endoscopy Division from July 2019 to March 2021 and as Vice President of Global Internal Audit from February 2017 to June 2019. Prior to Boston Scientific Corporation, Ms. Ambrose served as an accountant at Ernst & Young LLP. She received her B.S. in Commerce from the University of Virginia and is a Certified Public Accountant.

ITEM 1A. RISK FACTORS

Investing in our common stock involves a high degree of risk, and you should carefully consider the risks and uncertainties described below in addition to the other information included or incorporated by reference in this Annual Report on Form 10-K. If any of the following risks or uncertainties actually occurs, our business, financial condition or results of operations would likely suffer, possibly materially. In that case, the trading price of our common stock could decline.

SUMMARY OF RISK FACTORS

Our business is subject to numerous risks and uncertainties, discussed in more detail in the following section. These risks include, among others, the following key risks:

Risks Related to Our Business

- We invest significant resources in the research, development, manufacturing and supply of therapies for serious diseases other than CF, and if we are unable to successfully commercialize one or more of these therapies, our business could be materially harmed.
- All of our product revenues and the vast majority of our total revenues are derived from sales of medicines for the treatment of CF. If we are unable to continue to increase revenues from sales of our CF medicines or to eventually derive revenues from the sales of our pipeline products, our business would be materially harmed and the market price of our common stock would likely decline.
- We have limited experience developing and commercializing cell and genetic therapies and could experience challenges with these programs, which could result in delays or prevent the development, manufacturing and commercialization of our cell and genetic therapies.
- If our competitors bring products with superior product profiles to market, our products may not be competitive and our revenues could decline.
- If we discover safety issues with any of our products or if we fail to comply with continuing U.S. and applicable foreign regulations, commercialization efforts for the product could be negatively affected, the approved product could lose its approval or sales could be suspended, and our business could be materially harmed.
- If physicians and patients do not accept our products, or if patients do not remain on treatment or comply with their prescribed dosing regimen, our product revenues would be materially harmed in future periods.

Risks Related to Pricing of Our Products

- Government and other third-party payors seek to contain costs of health care through legislative and other means. If they fail to provide coverage and adequate reimbursement rates for our products, our revenues will be harmed.
- We may experience incremental pricing pressure on our products, which could reduce our revenues and future profitability.
- Current health care laws and regulations in the U.S. and future legislative or regulatory reforms to the U.S. health care system may affect our ability to commercialize our marketed products profitably.
- We have experienced challenges commercializing products outside of the U.S., and our future revenues will be dependent on our ability to obtain adequate reimbursement for our products.

Risks Related to Development and Clinical Testing of Our Products and Product Candidates

- Our product candidates remain subject to clinical testing and regulatory approval, and our future success is dependent on our ability to successfully develop additional product candidates for both CF and non-CF indications.
- If we are unable to obtain or are delayed in obtaining regulatory approval, we may incur additional costs, experience delays in commercialization, or be unable to commercialize our product candidates.
- If clinical trials are prolonged or delayed, our development timelines for the affected development program could be extended, our costs to develop the product candidate could increase and the competitive position of the product candidate could be adversely affected.
- Difficulty in enrolling patients could delay or prevent clinical trials of our product candidates, and ultimately delay or prevent regulatory approval.

Risks Related to Government Regulation

- If regulatory authorities interpret any of our conduct, including our marketing practices, as being in violation of applicable health care laws, including fraud and abuse laws, laws prohibiting off-label promotion, disclosure laws or other similar laws, we may be subject to civil or criminal penalties.
- If we fail to comply with our reporting and payment obligations under the Medicaid Drug Rebate Program or other governmental pricing programs in the U.S., we could be subject to additional reimbursement requirements, penalties, sanctions and fines that could have a material adverse effect on our business, financial condition, results of operations and growth prospects.
- If our processes and systems are not compliant with regulatory requirements, we could be subject to restrictions on marketing our products or could be delayed in submitting regulatory filings seeking approvals for our product candidates.
- We are subject to various and evolving laws and regulations governing the privacy and security of personal data, and our failure to comply could adversely affect our business, result in fines and/or criminal penalties, and damage our reputation.

Risks Related to Business Development Activities

- Our ability to execute on our long-term strategy depends in part on our ability to engage in transactions and collaborations with other entities that add to our pipeline or provide us with new commercial opportunities.
- We may not realize the anticipated benefits of acquisitions of businesses or technologies, and the integration following any such acquisition may disrupt our business and management.
- We face risks in connection with existing and future collaborations with respect to the development, manufacture and commercialization of our products and product candidates.
- We may not be able to attract collaborators or external funding for the development and commercialization of certain of our product candidates.

Risks Related to Supply, Manufacturing and Reliance on Third Parties

- We depend on third-party manufacturers and our internal capabilities to manufacture our products and the materials we require for our clinical trials. We may not be able to maintain our third-party relationships and could experience supply disruptions outside of our control.
- We rely on third parties to conduct pre-clinical work, clinical trials and other activities, and those third parties may not perform satisfactorily, including failing to meet established deadlines for the completion of such studies and/or trials or failing to satisfy regulatory requirements.

Risks Related to Intellectual Property

- If our patents do not protect our products or our products infringe third-party patents, we could be subject to litigation which could result in injunctions preventing us from selling our products or substantial liabilities.
- Uncertainty over intellectual property in the pharmaceutical and biotechnology industry has been the source of litigation and other disputes, that are inherently costly and unpredictable.
- We may be subject to claims by third parties asserting that our employees or we have misappropriated their intellectual property, or claiming ownership of what we regard as our own intellectual property.

Risks Related to Our Operations

- A variety of risks associated with operating in foreign countries could materially adversely affect our business.
- If we fail to attract and retain skilled employees, our business could be materially harmed.
- A breakdown or breach of our information technology systems could subject us to liability or interrupt the operation of our business.

Risks Related to Financial Results and Holding Our Common Stock

- Our effective tax rate fluctuates, and changes in tax laws, regulations and treaties, unfavorable resolution to the tax positions we have taken or exposure to additional income tax liabilities could have a material impact on our future taxable income.

Risks Related to Our Business

We invest significant resources in the research, development, manufacturing and supply of therapies for serious diseases other than CF, and if we are unable to successfully commercialize one or more of these therapies, our business could be materially harmed.

We invest significant resources in the research and development of medicines for serious diseases including SCD, beta thalassemia, pain, AMKD, T1D, AATD, DMD and DM1. Some of these programs have progressed into clinical trials, while others are still in pre-clinical development. Product development is highly uncertain and expensive, and we may experience unforeseen delays, including regulatory and commercialization delays. Product candidates that may appear promising in the early phases of research and development may fail to reach commercial success for many reasons, including the failure to demonstrate acceptable clinical trial results or obtain marketing approval, the inability to manufacture or commercialize the product candidate on economically feasible terms, or the appearance of safety issues. For example, in October 2020, we decided not to progress VX-814, a drug candidate for the treatment of AATD, into further development based on safety and pharmacokinetic data observed in a Phase 2 clinical trial.

Even if we gain marketing approval for one or more pipeline products, we cannot be sure that we will obtain market acceptance or adequate reimbursement levels from third-party payors or foreign governments for such products. Additionally, many of the therapies that we are developing in our pipeline target rare diseases that affect a limited number of patients. There can be no guarantee that we will effectively identify patients that are eligible for enrollment in our clinical trials or treatment with our product candidates. Even if we do successfully identify eligible patients, the number of patients that our product candidates are able to treat may turn out to be lower than we expect or new patients may become increasingly difficult to identify, each of which may adversely affect our revenues and materially harm our business. For these and other reasons, we may never be successful in expanding our pipeline and future revenue may continue to depend on sales of our CF medicines.

All of our product revenues and the vast majority of our total revenues are derived from sales of medicines for the treatment of CF. If we are unable to continue to increase revenues from sales of our CF medicines or to eventually derive revenues from the sales of our pipeline products, our business would be materially harmed and the market price of our common stock would likely decline.

Our net product revenues and the vast majority of our total revenues are derived from the sale of our CF medicines. As a result, our future success is largely dependent upon our ability to increase revenues from sales of our CF medicines. This will require us to continue to gain approval and reimbursement for TRIKAFTA/KAFTRIO in ex-U.S. markets, successfully develop and commercialize TRIKAFTA/KAFTRIO for younger children with CF or successfully develop and commercialize products from our pipeline.

Our concentrated source of revenues presents a number of risks to our business, including:

- that one or more competing therapies may be developed successfully as a treatment for people with CF;
- that reimbursement policies of payors and other third parties may make it difficult to obtain reimbursement or reduce the net price we receive for our products;
- that we may experience manufacturing or supply disruptions for our CF medicines; and
- that we may experience adverse developments with respect to development or commercialization of our CF medicines and/or pipeline product candidates.

If any of the above risks were to materialize, if we are otherwise unable to increase revenues from sales of our CF medicines, or if we do not meet the expectations of investors or public equity market analysts, our business would be materially harmed and our ability to fund our operations could be adversely affected.

We have limited experience developing and commercializing cell and genetic therapies and could experience challenges with these programs, which could result in delays or prevent the development, manufacturing and commercialization of our cell and genetic therapies.

We are investing significant resources in the research, development, manufacturing, and commercialization of cell and

genetic therapies, including exa-cel. While we have previously successfully developed, manufactured, and commercialized several small molecule drugs, we have limited experience with the development, manufacture, and commercialization of cell and genetic therapies. Development, manufacturing, and commercialization of cell and genetic therapies are subject to similar risks and uncertainties as small molecules. In addition:

- the manufacturing processes for cell and genetic therapies are different, less mature and more complex than the manufacturing processes required for small molecule drugs and require investments in systems, equipment, facilities, and expertise to develop and maintain;
- we may encounter difficulties in the production of our cell and genetic therapies and ensuring that the product meets required specifications;
- there have been a limited number of regulatory approvals for genetic therapies to date, the regulatory requirements governing genetic therapies continue to evolve, and regulatory positions and interpretations can change or lead to delays or significant unexpected costs with respect to our genetic therapy programs;
- the commercial success of cell or genetic therapies, including exa-cel and VX-880, if approved, will depend in part on the medical community, patients, governments, and third-party or governmental payors accepting and providing adequate reimbursement for cell or genetic therapy products in general, and recognizing the applicable medicine as medically useful, cost-effective, ethical, and safe; and
- market acceptance will be dependent in part on the prevalence and severity of side effects associated with the procedure by which the cell or genetic therapy is administered, including, with respect to exa-cel and VX-880, if approved, the prevalence and severity of any side effects resulting from the myeloablative preconditioning regime or immunosuppression, respectively.

For programs addressing rare genetic diseases with small patient populations, we may not be able to identify, recruit and enroll a sufficient number of patients, or those with required or desired characteristics, to complete our clinical studies in an adequate and timely manner. Additionally, patients may be unwilling to participate in our clinical trials because of concerns that cell and genetic therapies are unsafe or unethical, negative publicity from adverse events in the biotechnology or gene therapy industries, or for other reasons, including competitive clinical studies for similar patient populations. Moreover, adverse developments in clinical trials conducted by others of cell and genetic therapy products or products created using similar technology, or adverse public perception of the field of cell and genetic therapies, may cause the FDA and other regulatory bodies to revise the requirements for approval of any cell or genetic therapy product candidates we may develop or limit the use of products utilizing technologies such as ours, either of which could materially harm our business.

As we advance our cell and genetic therapy product candidates, we will be required to consult with various regulatory authorities, and we must comply with all applicable laws, rules, and regulations, which may change from time to time, including during the course of development of our cell and genetic therapy product candidates. If we fail to do so, we may be required to delay or discontinue the clinical development of certain of our cell and genetic therapy product candidates. These additional processes may result in a review and approval process that is longer than we otherwise would have expected. Even if we comply with applicable laws, rules, and regulations, and even if we maintain close coordination with the applicable regulatory authorities with oversight over our cell and genetic therapy product candidates, our development programs may experience delays or fail to succeed. Delay or failure to obtain, or unexpected costs in obtaining, the regulatory approval necessary to bring a potential cell or genetic therapy product to market would materially adversely affect our business, financial condition, results of operations and prospects.

The regulatory approval process and clinical trial requirements for cell and genetic therapies can be more expensive and take longer than for other, better known or more extensively studied product candidates, and regulatory requirements governing cell and genetic therapy products have changed frequently and may continue to change in the future. For example, the FDA established the Office of Tissues and Advanced Therapies within its Center for Biologics Evaluation and Research (“CBER”) to consolidate the review of cell therapies and related products, and the Cellular, Tissue and Gene Therapies Advisory Committee to advise CBER on its review. These and other regulatory review agencies, committees and advisory groups, and the requirements and guidelines they promulgate, may lengthen the regulatory review process, require us to perform additional preclinical studies or clinical trials, increase our development costs, lead to changes in regulatory positions and interpretations, delay or prevent approval and commercialization of these treatment candidates or lead to significant post-approval limitations or restrictions.

To develop and commercialize cell or genetic therapies, including exa-cel, we are incurring substantial expenditures to develop, contract for, or otherwise arrange for the necessary supplies and manufacturing capabilities. Additionally, the manufacture of cell and genetic therapies requires significant expertise. Even with the relevant experience and expertise, manufacturers of cell and genetic therapy products often encounter difficulties in production, including difficulties with production costs and yields, quality control, and compliance with federal, state and foreign regulations. We cannot make any assurances that these problems will not occur, or that we will be able to resolve or address problems that occur in a timely manner, or at all.

To the extent we develop manufacturing capabilities internally, there are many risks that could result in delays and additional costs, including the need to hire and train qualified employees and obtain access to necessary equipment and third-party technology. To the extent we partner with third parties to manufacture our cell or genetic therapies, the complexity in the manufacture of our products and product candidates may require lengthy technology transfers. In addition, the third parties on which we rely to manufacture our cell or genetic therapies may experience their own compliance challenges or delays.

We are also devoting substantial resources to expand our commercial organization to prepare for the anticipated future product launches from our pipeline programs. For example, with respect to exa-cel, we are creating and developing the internal and external support systems to reach and support potential future patients, in addition to establishing and ensuring the necessary supply and manufacturing infrastructure. We cannot make any assurances that we will obtain approval for products from our pipeline programs, or that, if approved, a future product will generate substantial revenues and cash flows.

We also face uncertainty as to whether cell and gene therapy treatments will gain the acceptance of the public or the medical community. If we obtain regulatory approval, the commercial success of cell and gene therapy treatments will depend, in part, on the acceptance of physicians, patients, and third-party payors of gene therapy products in general, and our product candidates in particular, as medically necessary, cost-effective, and safe. In particular, our success will depend upon physicians prescribing our product candidates in lieu of existing treatments they are already familiar with and for which greater clinical data may be available. Moreover, physicians and patients may delay acceptance of cell and gene therapy product candidates until the product candidates have been on the market for a certain amount of time. In addition, medical centers that administer procedures accompanying treatment could experience capacity constraints, and these centers are subject to competing priorities that could delay patient access to procedures associated with cell and gene therapy products. Negative public opinion or more restrictive government regulations may delay or impair the successful commercialization of, and demand for, cell and gene therapies.

There also is significant uncertainty related to the insurance coverage and reimbursement of cell or genetic therapy products, including gene therapies that are potential one-time treatments. It is difficult to predict what third party payors, including U.S. or ex-U.S. governments or private insurance companies, will decide with respect to reimbursement for novel cell and genetic therapies like the ones in our pipeline. Additionally, reimbursement rates for cell and genetic therapies approved before ours could create an adverse environment for reimbursement of any therapies we ultimately commercialize. The administration of our products may require procedures for the collection of cells from patients, followed by other procedures either before or after delivery of the cell or genetic therapy. The manner and level at which reimbursement is provided for these services also is important. Inadequate reimbursement for such services may adversely affect physicians' decisions to recommend any product for which we obtain approval in the future and our ability to market or sell the associated cell or genetic therapy.

Given there are only a few approved cell and genetic therapy products, it also is difficult to determine how long it will take or reasonably estimate the costs to develop, manufacture, and commercialize cell or genetic therapies. In addition, our cell-based therapies include approaches involving devices, which are subject to additional regulatory requirements. If we are unable to successfully develop, manufacture, or commercialize such therapies on a timely or profitable basis, or at all, we may not realize benefits or generate cash flows based on our investments in these programs and our business, financial condition, results of operations and our stock price would likely be adversely affected.

If our competitors bring products with superior product profiles to market, our products may not be competitive and our revenues could decline.

A number of companies are seeking to identify and develop product candidates for the treatment of CF and other therapeutic areas we are targeting with our research and development activities. Our success in rapidly developing and commercializing our CF medicines may increase the resources that our competitors allocate to the development of potential

competitive treatments. If one or more competing therapies are successfully developed as a treatment for people with CF or any of the other diseases we are currently targeting in our pipeline, our products and our net product revenues could face competitive pressures. If one or more competing therapies prove to be superior to our then existing products and/or product candidates, our business could be materially adversely affected.

In addition, our business faces competition from major pharmaceutical companies possessing substantially greater financial resources than we possess. We also face competition from numerous smaller public and private companies, academic institutions, government agencies, public and private research organizations, and charitable venture philanthropy organizations that conduct research, seek patent protection, and/or establish collaborative arrangements for research, development, manufacturing, and commercialization.

Mergers and acquisitions in the pharmaceutical and biotechnology industries may result in even more resources being concentrated among a smaller number of our competitors. Smaller and other early-stage companies also may prove to be significant competitors, particularly through collaborative arrangements with large and established companies. These third parties compete with us in recruiting and retaining qualified scientific and management personnel, establishing clinical trial sites and patient registration for clinical trials, as well as in acquiring technologies complementary to, or necessary for, our programs.

Our products and any products that we develop in the future may not be able to compete effectively with marketed drugs or new drugs that may be developed by competitors. The risk of competition is particularly important to our company because substantially all of our revenues are related to the treatment of people with CF. There are many other companies developing products for the same patient populations that we are pursuing. To compete successfully in these areas, we must demonstrate improved safety, efficacy and/or tolerability, ease of manufacturing, and gain and maintain market acceptance over competing products.

If we discover safety issues with any of our products or if we fail to comply with continuing U.S. and applicable foreign regulations, commercialization efforts for the product could be negatively affected, the approved product could lose its approval or sales could be suspended, and our business could be materially harmed.

Our products are subject to continuing regulatory oversight, including the review of additional safety information. Products are more widely used by patients once approval has been obtained and therefore side effects and other problems may be observed after approval that were not seen or anticipated, or were not as prevalent or severe, during pre-approval clinical trials or nonclinical studies. The subsequent discovery of previously unknown or underestimated problems with a product could negatively affect commercial sales of the product, result in restrictions on the product or lead to the withdrawal of the product from the market. Each of our CF products shares at least one active pharmaceutical ingredient with another of our products. As a result, if any of our CF products were to experience safety issues, our other CF products may be adversely affected. The reporting of adverse safety events involving our products or public speculation about such events could cause our stock price to decline or experience periods of volatility. Our business also may be materially harmed by impaired sales of our products, denial or withdrawal of regulatory approvals, required label changes or additional clinical trials, reputational harm, or government investigations or lawsuits brought against us.

Our products are subject to ongoing regulatory requirements governing the testing, manufacturing, labeling, packaging, storage, advertising, promotion, sale, distribution, import, export, recordkeeping, and submission of safety and other post-market information. We and our third-party manufacturers must comply with cGMP and other applicable regulations governing the manufacturing and distribution of our products. Regulatory authorities periodically inspect our drug manufacturing facilities, and those of our third-party manufacturers, to evaluate compliance with cGMP and other regulatory requirements.

If we or our collaborators, or third-parties acting on our behalf, fail to comply with applicable continuing regulatory requirements, we or our collaborators may be subject to fines, suspension or withdrawal of regulatory approvals for specific products, product recalls and seizures, operating restrictions and/or criminal prosecutions, any of which could have a material adverse effect on our business, reputation, financial condition, and results of operations.

In addition, treatment with some of our cell and genetic therapy product candidates, including exa-cel and VX-880, involve myeloablative preconditioning regimens or immunosuppression, and the patients in our clinical trials receiving these treatments may experience side effects (ranging from mild to severe) or adverse events. Such events could have a significant negative impact on our ability to develop or commercialize our product candidates.

If physicians and patients do not accept our products, or if patients do not remain on treatment or comply with their prescribed dosing regimen, our product revenues would be materially harmed in future periods.

Our medicines may not gain or maintain market acceptance among physicians and patients or other members of the medical community. Effectively marketing our products and any of our product candidates or investigational therapies, if approved, requires substantial efforts, both prior to launch and after approval. Physicians may elect not to prescribe our products or recommend our cell or genetic therapies, and patients may elect not to take them or receive them or they may discontinue use of our products after initiation of treatment, for a variety of reasons including:

- prevalence and severity of adverse side effects;
- lack of reimbursement availability from third-party payors, including governmental entities;
- lower demonstrated efficacy, safety and/or tolerability compared to alternative treatment methods;
- lack of cost-effectiveness;
- a decision to wait for the approval of other therapies in development that have significant perceived advantages over our product;
- convenience and ease of administration;
- limitations or warnings contained in the labeling;
- the timing of market introduction of our product as well as competitive products;
- other potential advantages of alternative treatment methods; and
- inadequate sales, marketing and/or distribution support, including as a result of limitations or restrictions resulting from COVID-19.

If our medicines fail to achieve or maintain market acceptance, we may not be able to generate significant revenues in future periods.

We are dependent upon a small number of customers for a significant portion of our revenue, and the loss of, or significant reduction in sales to, these customers would adversely affect our results of operations.

In the U.S., we sell our CF products principally to a limited number of specialty pharmacy and specialty distributors, which subsequently resell our products to patients and health care providers. Internationally, we sell our products primarily through distributor arrangements and to a limited number of retail pharmacies or pharmacy chains, as well as to hospitals and clinics. We expect this significant customer concentration in CF to continue for the foreseeable future. Our ability to generate and grow sales of our CF medicines will depend significantly on the extent to which these specialty distributors and specialty pharmacies are able to provide adequate distribution of our products to patients and healthcare providers. The loss of any large customer, a significant reduction in sales we make to them, any cancellation of orders they have made with us, or any failure to pay for the products we have shipped to them could adversely affect our business, financial condition, and results of operations.

Risks Related to Pricing of Our Products

Government and other third-party payors seek to contain costs of health care through legislative and other means. If they fail to provide coverage and adequate reimbursement rates for our products, our revenues will be harmed.

Sales of our products depend in part upon the availability of reimbursement from third-party payors. Third-party payors include government health programs such as Medicare and Medicaid in the U.S. and the national health care systems in ex-U.S. markets, managed care providers, private health insurers and other organizations. The trend in the health care industry is cost containment, and efforts of third-party payors to contain or reduce health care costs may adversely affect our ability to establish or maintain appropriate prices for our products or any drugs that we may develop and commercialize.

In the U.S., there have been, and we expect that there will continue to be, a number of federal and state proposals to implement governmental controls that are similar to those that currently exist in Europe. For example, the ACA required

manufacturers of Medicare Part D brand name drugs to provide discounts on those drugs to Medicare Part D beneficiaries during the coverage gap; increased the rebates paid by pharmaceutical companies to state Medicaid programs on drugs covered by Medicaid; and imposed an annual fee, which increases annually, on sales by branded pharmaceutical manufacturers. Additionally, private payors, including health maintenance organizations and pharmacy benefit managers in the U.S., are adopting more aggressive utilization management techniques and are increasingly applying restrictive plan designs that can impact patients and manufacturers, and they continue to push for significant discounts and rebates from manufacturers.

Additionally, on August 16, 2022, the Inflation Reduction Act was enacted. The law establishes a Drug Price Negotiation Program, under which the government may negotiate maximum fair prices for certain drugs covered by Medicare that do not have generic or biosimilar competition. The first set of maximum fair prices will be effective in 2026. Certain products are excluded from the negotiation program including drugs that have a single orphan drug designation and that are not approved for any other orphan or non-orphan diseases or conditions. We cannot predict with certainty whether there will be future legislative changes to the scope of these exclusions. The law also requires manufacturers to pay a rebate to Medicare if the price of a Medicare drug (under both Part B and Part D) increases faster than the rate of inflation. The law also redesigns the Part D benefit. The current Coverage Gap Discount Program, which requires manufacturers to provide a 70% discount on brand drugs and biologics during the coverage gap phase, will be eliminated after the 2024 plan year. Starting in 2025, manufacturers of brand drugs and biologics will be required to provide a 10% discount during the initial phase and a 20% discount during the catastrophic phase of the Part D benefit. The Inflation Reduction Act continues a trend in the United States toward reducing drug prices and limiting spending by the federal health care programs on drugs. We cannot predict how CMS will interpret the Inflation Reduction Act or how the provisions of the law will affect our business once fully implemented, but it is possible that these changes or other legislative updates will have an adverse impact on our revenue. The Inflation Reduction Act also requires the Secretary of the Department of Health and Human Services to issue program guidance on numerous areas associated with implementation of the law's requirements, including for drug price negotiation and inflation rebates. We cannot know what form this program guidance would take or how it would affect our business.

It is possible the U.S. Congress or administration may take further actions to control prescription drug pricing. For example, in October 2022, President Biden issued an Executive Order, directing the Center for Medicare and Medicaid Innovation ("CMMI"), to consider new healthcare payment and delivery models that would lower drug costs and promote access to innovative drug therapies for Medicare and Medicaid beneficiaries. The Executive Order requires CMMI to submit a report to the White House on potential models.

Third-party payors throughout the world also have been attempting to control drug spending in light of the global economic pressures, including due to COVID-19. In reimbursement negotiations, many payors are requesting price discounts and caps on total expenditures and limiting both the types and variety of drugs that they will cover if they are not able to secure them. Some payors restrict reimbursement to certain patient groups or by indication. As part of these negotiations, many ex-U.S. government payors also are requiring companies to establish product cost-effectiveness as a condition of reimbursement. These cost-effectiveness reviews may overlook many of the benefits provided by innovative medicines, and for the most part, have not taken into account the specific circumstances of products that treat rare diseases. This has led to conclusions that certain medicines, including our products in certain jurisdictions, are not cost-effective. As a result, certain countries have declined to reimburse, or delayed their reimbursement of, some of our products. Although not mandated in the U.S., various organizations have started advocating for cost-effectiveness analyses in the U.S. as well as value-based contracting in which the amount of reimbursement for a product is based on patient outcomes and other clinical or economic metrics related to the performance of such product. If U.S. payors were to adopt such assessments and make negative coverage determinations or utilize value-based contracts that result in penalties to, or lower rates of, reimbursement, it could adversely affect our product revenues. Our business would be materially adversely affected if we are not able to obtain or maintain coverage and reimbursement of our products from third-party payors on a broad, timely, or satisfactory basis, or if such coverage is subject to overly broad or restrictive utilization management controls.

The increasing availability and use of innovative specialty pharmaceuticals for rare diseases, combined with their higher cost as compared to other types of pharmaceutical products, is generating significant third-party payor interest in developing cost-containment strategies targeted to this sector. Government regulations in both U.S. and ex-U.S. markets could further limit the prices that can be charged for our products and may limit our commercial opportunity. The increasing use of cost-effectiveness assessments in markets around the world and the financial challenges faced by many governments may lead to significant adverse effects on our business.

We may experience incremental pricing pressure on our products, which could reduce our revenues and future profitability.

There also has been an increase in state legislation and regulations related to drug pricing and drug pricing transparency. In the U.S., various states, including Nevada, Maryland, Louisiana, New York, California, Washington, Massachusetts, New Jersey, Connecticut, Vermont, New Hampshire, Utah, Minnesota, Oregon, Colorado, New Mexico, Virginia, Maine, Texas, North Dakota, and West Virginia, have passed legislation requiring companies to disclose extensive information relating to drug prices, drug price increases, and spending on research, development, and marketing, among other things. Although it is not always clear what states will do with the collected information, some laws were designed to obtain additional product discounts. Additionally, certain states have enacted laws establishing Prescription Drug Affordability Boards ("PDABs"). Some state PDABs either have the authority or have defined a pathway where they may be granted the authority, to establish upper payment limits for prescription drugs—although to date, none of the states have exercised this authority. We may continue to see more state action requiring additional disclosures or other actions. In addition, we could see increased federal activity related to drug pricing and transparency requiring disclosures or other actions instead of, or in addition to, state requirements. Similar initiatives also are occurring in, or being considered by, some of our ex-U.S. markets, including Italy and Brazil.

Complying with these laws can be expensive and requires significant personnel and operational resources. Furthermore, any additional required discounts would adversely affect the pricing of, and revenues from, our products. Finally, while we seek to comply with all statutory and regulatory requirements, we face increased enforcement activity by the U.S. federal government, state governments, and private payors against pharmaceutical and biotechnology companies for pricing and reimbursement-related issues as well as inquiries from the U.S. Congress.

Other federal activities seeking to specifically address drug pricing and reimbursement include:

- rulemaking related to importation of prescription drugs from Canada, as well as guidance related to importation of prescription drugs from other foreign countries;
- attempts to establish reference pricing for certain physician-administered drugs;
- executive orders relating to drug pricing that are intended to broadly impact the pharmaceutical industry;
- changes to the federal anti-kickback statute safe harbors that eliminate anti-kickback statute discount safe harbor protection for certain manufacturer rebate arrangements; and
- legislation relating to drug pricing, including enhanced transparency measures into drug pricing.

We expect government scrutiny over drug pricing, reimbursement, and distribution to continue. Potential future government regulation of drug prices or reimbursement creates uncertainties about our portfolio and could have a material adverse effect on our operations.

Current health care laws and regulations in the U.S. and future legislative or regulatory reforms to the U.S. health care system may affect our ability to commercialize our marketed products profitably.

The U.S. government, individual states and some foreign jurisdictions also have been aggressively pursuing legislative and regulatory reforms that could affect our ability to sell products. For example, in the U.S., there have been federal legislative and administrative efforts to repeal, substantially modify, or invalidate some or all of the provisions of the ACA, which could affect coverage and payment for medicines. The federal government additionally has proposed and enacted legislation leading to aggregate reductions of Medicare payments to providers, which ultimately could affect utilization of medicines.

Other reforms include the Bipartisan Budget Act of 2018, which contained various provisions that affect coverage and reimbursement of drugs, including an increase in the discount that manufacturers of Medicare Part D brand name drugs must provide to Medicare Part D beneficiaries during the coverage gap from 50% to 70%. Under the Inflation Reduction Act, the coverage gap phase and the associated coverage gap discount program will be eliminated after the 2024 plan year. Starting in 2025, there will be a new Part D manufacturer discount program, which requires a 10% discount in the initial phase and a 20% discount in the catastrophic phase of the benefit. The Inflation Reduction Act also authorizes the government to negotiate maximum fair prices for certain Medicare drugs. It also establishes mandatory rebates for Part B and Part D drugs

with prices that increase faster than inflation. These new laws or any other similar laws introduced in the future may result in additional reductions in Medicare and other health care funding, which could negatively affect our customers and accordingly, our financial operations. Moreover, payment methodologies may be subject to changes in health care legislation and regulatory initiatives. For example, CMS may develop new payment and delivery models, such as bundled payment models.

Adoption of new health care reform legislation at the federal or state level could affect demand for, or pricing of, our products or product candidates if approved for sale. We cannot, however, predict the ultimate content, timing, or effect of any health care reform legislation or action, or its impact on us, including increased compliance requirements and costs, all of which may adversely affect our future business, operations, and financial results.

We have experienced challenges commercializing products outside of the U.S., and our future revenues will be dependent on our ability to obtain adequate reimbursement for our products.

In most ex-U.S. markets, the pricing and reimbursement of therapeutic and other pharmaceutical products is subject to governmental control and government authorities are making greater efforts to limit or regulate the price of drug products. The reimbursement process in ex-U.S. markets can take a significant time to conclude and reimbursement decisions are made on a country-by-country or region-by-region basis. Further, many ex-U.S. governments are introducing new legislation focusing on cost containment measures in the pharmaceutical industry. The final form of these laws and the relevant practical application is unknown at this time, but may lead to lower prices, paybacks or other forms of discounts or special taxes.

Our medicines treat life-threatening conditions and address relatively small patient populations, and our research and development programs are primarily focused on developing medicines to treat similar diseases. Both government and private payors are targeting these types of high cost medicines, in some cases refusing to pay for them. We have experienced challenges in obtaining timely reimbursement for our products in various countries outside the U.S. For example, we obtained reimbursement for ORKAMBI and SYMKEVI in England in the fourth quarter of 2019, four years after ORKAMBI's initial approval in 2015. Our future product revenues, including from TRIKAFTA/KAFTRIO, depend on, among other things, our ability to maintain reimbursement in ex-U.S. markets for our products. There is no assurance that coverage and reimbursement will be available outside of the U.S. for our four approved medicines or any future medicine, and, even if it is available, whether the timing or the level of reimbursement will be sufficient to allow us to market our medicines. Adverse pricing limitations or a delay in obtaining coverage and reimbursement would decrease our future net product revenues and harm our business.

Risks Related to Development and Clinical Testing of Our Products and Product Candidates

Our product candidates remain subject to clinical testing and regulatory approval, and our future success is dependent on our ability to successfully develop additional product candidates for both CF and non-CF indications.

Our business depends upon the successful development and commercialization of product candidates. These product candidates are in various stages of development and must satisfy rigorous standards of safety and efficacy before they can be approved for sale by the FDA or comparable foreign regulatory authorities. To satisfy these standards, we must allocate resources among our various development programs and must engage in expensive and lengthy testing of our product candidates. Discovery and development efforts for new pharmaceutical and biological products, including new combination therapies, are resource-intensive and may take 10 to 15 years or longer for each product candidate. It is impossible to predict when or if any of our product candidates will prove effective and safe in humans or will receive regulatory approval. Despite our efforts, our product candidates may not:

- offer therapeutic or other improvement over existing competitive therapies;
- show the level of safety and efficacy, including the level of statistical significance, required by the FDA or other regulatory authorities for approval of a drug or biologic;
- meet applicable regulatory standards;
- be capable of being produced in commercial quantities at acceptable costs; or
- if approved for commercial sale, be successfully marketed as pharmaceutical or biological products.

We have recently completed and/or have ongoing or planned clinical trials for several of our product candidates. The strength of our product portfolio and pipeline will depend in large part upon the outcomes of these clinical trials, including those evaluating TRIKAFTA/KAFTRIO in younger children with CF, our CF pipeline products, exa-cel and VX-548 in pain. Failure to advance product candidates through clinical development could impair our ability to ultimately commercialize products, which could materially harm our business and long-term prospects.

Results of our clinical trials and findings from our nonclinical studies, including toxicology findings in nonclinical studies conducted concurrently with clinical trials, could lead to abrupt changes in our development activities, including the possible cessation of development activities associated with a particular product candidate or program. For example, in October 2020, we decided not to progress VX-814, a drug candidate for the treatment of AATD, into further development based on safety and pharmacokinetic data observed in a Phase 2 clinical trial.

Moreover, clinical data are often susceptible to varying interpretations, and many companies that have believed their product candidates performed satisfactorily in clinical trials have nonetheless failed to obtain marketing approval of their product candidate. Furthermore, results from our clinical trials may not meet the level of statistical significance or otherwise provide the level of evidence or safety and efficacy required by the FDA or other regulatory authorities for approval of a product candidate. Finally, clinical trials are expensive and require significant operational resources to implement and maintain.

Many companies in the pharmaceutical and biotechnology industries, including our company, have suffered significant setbacks in later-stage clinical trials even after achieving promising results in earlier-stage clinical trials. For example, the results from completed preclinical studies and clinical trials may not be replicated in later clinical trials, and ongoing clinical trials for our product candidates may not be predictive of the results we may obtain in later-stage clinical trials or of the likelihood of approval of a product candidate for commercial sale.

In addition, from time to time, we report interim, topline, and preliminary data from our clinical trials, which is based on a preliminary analysis of then-available data, and the results and related findings and conclusions are subject to change. Interim or preliminary data from a clinical trial may not be predictive of final results from the clinical trial and are subject to the risk that one or more of the clinical outcomes may materially change as patient enrollment and treatment continues and more patient data become available or as patients from our clinical trials continue other treatments for their disease. Topline data also remain subject to audit and verification procedures that may result in the final data being materially different from the preliminary data we previously published. As a result, topline data should be viewed with caution until the final data are available. If the interim, topline, or preliminary data that we report differ from actual results, or if others, including regulatory authorities, disagree with the conclusions reached, our ability to obtain approval for, and commercialize, our product candidates may be harmed, which could harm our business, operating results, prospects or financial condition.

The ability of third parties to review and/or analyze data from our clinical trials, including as a result of government disclosure, also may increase the risk of commercial confidentiality breaches and result in enhanced scrutiny of our clinical trial results. For example, Clinical Trial Regulation (EU) No. 536/2014, and the EMA policy on publication of clinical data for medicinal products for human use, both permit the EMA to publish clinical information submitted in marketing authorization applications. Third party review and scrutiny could result in public misconceptions regarding our drugs and product candidates. These publications could also result in the disclosure of information to our competitors that we might otherwise deem confidential, which could harm our business.

If we are unable to obtain or are delayed in obtaining regulatory approval, we may incur additional costs, experience delays in commercialization, or be unable to commercialize our product candidates.

The time required to complete clinical trials and to satisfy the FDA and other countries' regulatory review processes is uncertain and typically takes many years. Our analysis of data obtained from nonclinical and clinical activities is subject to confirmation and interpretation by regulatory authorities, which could delay, limit or prevent regulatory approval. We also may encounter unanticipated delays or increased costs due to government regulation from future legislation or administrative action or changes in governmental policy during the period of drug development, clinical trials and governmental regulatory review.

We may seek a Fast Track, Priority Review, Breakthrough Therapy, and/or RMAT designation for some of our product candidates. Product candidates that receive one or more of these designations may be eligible for, among other things, a priority regulatory review. Each of these designations is within the discretion of the FDA. Accordingly, even if we believe

one of our product candidates meets the criteria for Fast Track, Priority Review, Breakthrough Therapy and/or RMAT designation, the FDA may disagree and instead determine not to make such designation. The receipt of one or more of these designations for a product candidate does not guarantee a faster development process, review or approval compared to products developed or considered for approval under conventional FDA procedures and does not assure ultimate approval by the FDA. In addition, even if one or more of our products or product candidates qualifies for Fast Track, Priority Review, Breakthrough Therapy and/or RMAT designation, the FDA may later decide to withdraw such designation if it determines that the product or product candidate no longer meets the conditions for qualification.

Any failure to obtain regulatory approvals for a product candidate would prevent us from commercializing that product candidate. Any delay in obtaining required regulatory approvals could materially adversely affect our ability to successfully commercialize a product candidate. Furthermore, any regulatory approval to market a product may be subject to limitations that we do not expect on the indicated uses for which we may market the product. Any such limitations could reduce the size or demand of the market for the drug.

We also are subject to numerous foreign regulatory requirements governing the conduct of clinical trials, manufacturing and marketing authorization, pricing and third-party reimbursement. Non-U.S. jurisdictions have different approval procedures than those required by the FDA, and these jurisdictions may impose additional testing requirements for our product candidates. The foreign regulatory approval process includes all of the risks associated with the FDA approval process described above, as well as risks attributable to the satisfaction of foreign requirements. Approval by the FDA does not ensure approval by regulatory authorities outside the U.S. and approval by a foreign regulatory authority does not ensure approval by the FDA. In addition, although the FDA may accept data from clinical trials conducted outside the U.S., acceptance of this data is subject to conditions imposed by the FDA. For example, the clinical trial must be well designed and conducted and performed by qualified investigators in accordance with ethical principles. The trial population also must adequately represent the U.S. population, and the data must be applicable to the U.S. population and U.S. medical practice in ways that the FDA deems clinically meaningful. In addition, while these clinical trials are subject to applicable local laws, FDA acceptance of the data will depend on its determination that the trials also complied with all applicable U.S. laws and regulations. If the FDA does not accept the data from any trial that we conduct outside the U.S., it would likely result in the need for additional trials, which would be costly and time-consuming and delay or permanently halt our development of the applicable product candidate.

If clinical trials are prolonged or delayed, our development timelines for the affected development program could be extended, our costs to develop the product candidate could increase and the competitive position of the product candidate could be adversely affected.

We cannot predict whether or not we will encounter problems with any of our completed, ongoing or planned clinical trials that will cause us or regulatory authorities to delay or suspend clinical trials, or delay the analysis of data from our completed or ongoing clinical trials. Among the factors that could delay our development programs are:

- ongoing discussions with the FDA or comparable foreign authorities regarding the scope or design of our clinical trials and the number of clinical trials we must conduct;
- failure or delay in reaching agreement on acceptable terms with prospective contract research organizations (“CROs”) and clinical trial sites;
- failure to add or delay in adding a sufficient number of clinical trial sites and obtaining institutional review board or independent ethics committee approval at each clinical trial site;
- suspension or termination of clinical trials of product candidates for various reasons, including non-compliance with regulatory requirements;
- clinical trial sites deviating from clinical trial protocol or dropping out of a clinical trial;
- delays in enrolling volunteers or patients into clinical trials, including as a result of low numbers of patients that meet the eligibility criteria for the trial;
- a lower than anticipated retention rate of volunteers or patients in clinical trials;

- the need to repeat clinical trials as a result of unfavorable or inconclusive results, unforeseen complications in testing or clinical investigator error;
- inadequate supply or deficient quality of product candidate materials or other materials necessary for the conduct of our clinical trials;
- unfavorable FDA or foreign regulatory authority inspection and review of a manufacturing facility that supplied clinical trial materials or its relevant manufacturing records or a clinical trial site or records of any clinical or preclinical investigation;
- unfavorable or inconclusive scientific results from clinical trials;
- serious and unexpected treatment-related side-effects experienced by participants in our clinical trials or by participants in clinical trials being conducted by our competitors to evaluate product candidates with similar mechanisms of action or structures to therapies that we are developing;
- favorable results in testing of our competitors' product candidates, or FDA or foreign regulatory authority approval of our competitors' product candidates; or
- action by the FDA or a foreign regulatory authority to place a clinical hold or partial clinical hold on a trial or compound or deeming the clinical trial conduct as problematic.

For planning purposes, we estimate the timing of the accomplishment of various scientific, clinical, regulatory, and other product development goals, which we sometimes refer to as milestones. These milestones may include the commencement or completion of scientific studies and clinical trials and the submission of regulatory filings. From time to time, we publicly announce the expected timing of some of these milestones. All of these milestones are based on a variety of assumptions. The actual timing of these milestones can vary dramatically compared to our estimates, in many cases for reasons beyond our control. If we do not meet these milestones as publicly announced, the commercialization of our products may be delayed and the credibility of our estimates may be adversely affected and, as a result, our stock price may decline.

Difficulty in enrolling patients could delay or prevent clinical trials of our product candidates, and ultimately delay or prevent regulatory approval.

Our ability to enroll patients in our clinical trials in sufficient numbers and on a timely basis is subject to a number of factors. Clinical trials are expensive and require significant operational resources. Delays in patient enrollment or unforeseen drop-out rates may result in increased costs and longer development times. The enrollment of patients further depends on many factors, including:

- the proximity of patients to clinical trial sites;
- the size of the patient population, the nature of the protocol, and the design of the clinical trial;
- our ability to recruit clinical trial investigators with the appropriate competencies and experience;
- the number of other clinical trials ongoing and competing for patients in the same indication;
- our ability to obtain and maintain patient consents;
- reporting of the preliminary results of any of our clinical trials;
- the availability of effective treatments for the relevant disease and eligibility criteria for the clinical trial;
- the risk that patients enrolled in clinical trials will drop out of the clinical trials before clinical trial completion; and
- factors we may not be able to control, such as current or potential pandemics that may limit patients, principal investigators or staff or clinical site availability (e.g., the COVID-19 pandemic).

We, our collaborators, the FDA, or other applicable regulatory authorities may suspend clinical trials of a product candidate at any time if we or they believe the healthy volunteers or patients participating in such clinical trials are being exposed to unacceptable health risks or for other reasons. Any such suspension could materially adversely affect the

development of a particular product candidate and our business.

Risks Related to Government Regulation

If regulatory authorities interpret any of our conduct, including our marketing practices, as being in violation of applicable health care laws, including fraud and abuse laws, laws prohibiting off-label promotion, disclosure laws or other similar laws, we may be subject to civil or criminal penalties.

We are subject to health care fraud and abuse laws, such as the FCA and the AKS, and other similar laws and regulations both in the U.S. and in non-U.S. markets.

In the U.S., the Federal Anti-Kickback Statute prohibits knowingly and willfully offering, paying, soliciting, receiving or providing remuneration, directly or indirectly, in exchange for or to induce either the referral of an individual, or the ordering, furnishing, arranging for or recommending of an item or service that is reimbursable, in whole or in part, by a federal health care program, such as Medicare or Medicaid. Because of the broad scope of the prohibition, most financial interactions between pharmaceutical manufacturers and prescribers, purchasers, third party payors and patients would be subject to the statute. Although there are a number of statutory exceptions and regulatory safe harbors protecting certain common activities from prosecution, the exceptions and safe harbors are narrow. Financial interactions must therefore be structured carefully to qualify for protection or otherwise withstand scrutiny.

Federal false claims laws, including the FCA, prohibit any person from knowingly presenting, or causing to be presented, a false claim for payment to the federal government, or knowingly making, or causing to be made, a false statement to get a false claim paid. Pharmaceutical companies have been prosecuted under these laws for a variety of alleged promotional and marketing activities, such as providing free product to customers with the expectation that the customers would bill federal programs for the product; reporting to pricing services inflated average wholesale prices that were then used by federal programs to set reimbursement rates; engaging in promotion for uses that the FDA has not approved, known as “off-label” uses, that caused claims to be submitted to Medicaid for those off-label uses; submitting inflated “best price” information to the Medicaid Rebate Program; and certain manufacturing-related violations. The scope of this and other laws may expand in ways that make compliance more difficult and expensive.

The FDA and other regulatory agencies closely regulate the post-approval marketing and promotion of products to ensure that they are marketed only for the approved indications and in accordance with the provisions of the approved labeling. Although physicians are permitted, based on their medical judgment, to prescribe products for indications other than those approved by the FDA, manufacturers are prohibited from promoting their products for such off-label uses. We market our products to eligible people with CF for whom the applicable product has been approved and provide promotional materials and training programs to physicians regarding the use of each product in these patient populations. These eligible people do not represent all people with CF. If the FDA determines that our promotional materials, training, or other activities constitute off-label promotion, it could request that we modify our training or promotional materials or other activities, conduct corrective advertising, or subject us to regulatory enforcement actions, including the issuance of a warning or untitled letter, injunction, seizure, civil fines and criminal penalties. It also is possible that other federal, state, or foreign enforcement authorities might take action if they believe that the alleged improper promotion led to the submission and payment of claims for an off-label use, which could result in significant fines or penalties under other statutory authorities, such as laws prohibiting false claims for reimbursement. Even if it is later determined we were not in violation of these laws, we may be faced with negative publicity, incur significant expenses defending our actions, and have to divert significant management resources from other matters.

In the U.S., federal and state laws regulate financial interactions between pharmaceutical manufacturers and healthcare providers, require disclosure to government authorities and the public of such interactions, and mandate the adoption of compliance standards or programs. For example, the so-called federal “sunshine law” requires pharmaceutical manufacturers to report annually to CMS payments or other transfers of value made by that entity to physicians and teaching hospitals (and additional categories of health care practitioners beginning with reports submitted on or after January 1, 2022). We also have similar reporting obligations with respect to financial interactions throughout the E.U. We expended significant efforts to establish, and are continuing to devote significant resources to maintain and enhance, systems and processes to comply with these regulations. Requirements to track and disclose financial interactions with health care providers and organizations increase government and public scrutiny of these financial interactions. Failure to comply with the reporting requirements could result in significant civil monetary penalties.

The sales and marketing practices of our industry have been the subject of increased scrutiny from government authorities in the U.S. and other countries in which we market our products, and we believe that this trend will continue. Many of these laws have not been fully interpreted by the government authorities or the courts, and their provisions are subject to a variety of interpretations. While we have a corporate compliance program which, together with our policies and procedures, is designed to actively identify, prevent and mitigate risk through the implementation of compliance policies and systems and the promotion of a culture of compliance, if we are found not to be in full compliance with these laws and regulations, our business could be materially harmed. We may be subject to penalties, including civil and criminal penalties, damages, fines, exclusion from federal health care programs and/or the curtailment or restructuring of our operations. Even if we successfully defend against government challenge, responding to the challenge may cause us to incur significant legal expenses and divert our management's attention from the operation of our business.

If we fail to comply with our reporting and payment obligations under the Medicaid Drug Rebate Program or other governmental pricing programs in the U.S., we could be subject to additional reimbursement requirements, penalties, sanctions and fines that could have a material adverse effect on our business, financial condition, results of operations and growth prospects.

We participate in the Medicaid Drug Rebate Program, the 340B program, and a number of other federal and state government pricing programs in the U.S. to obtain coverage for our products by certain government health care programs. These programs require us to pay rebates or provide discounts to certain government payors or private purchasers in connection with our products when dispensed to beneficiaries of these programs. In some cases, such as with the Medicaid Drug Rebate Program, the rebates are based on pricing and rebate calculations that we report on a monthly and quarterly basis to the government agencies that administer the programs. The terms, scope and complexity of these government pricing programs change frequently. For example, regulations finalized in December 2020 created an alternative Medicaid rebate formula for "line extensions" of oral solid dosage forms. Moreover, in December 2020, CMS finalized changes to Medicaid Drug Rebate Program pricing calculations regarding the provision of co-payment assistance to patients that may be impacted by so-called accumulator programs operated by private insurers or pharmacy benefit managers. The portion of this rule dealing with manufacturer co-payment assistance was struck down by the U.S. District Court for the District of Columbia in May 2022 (and the deadline for an appeal has lapsed). Consequently, while this rule has been vacated, it is possible that CMS could issue new rulemaking or guidance on this topic that would affect rebates owed under the Medicaid program or otherwise limit our ability to support our patient co-pay assistance program.

Additionally, the expansion of the 340B Drug Discount Program through the ACA has increased the number of purchasers who are eligible for significant discounts on branded drugs. These and future changes to government pricing programs, laws, and regulations may have a material adverse impact on our revenue and operations.

We also may have reimbursement obligations or be subject to penalties if we fail to provide timely and accurate information to the government, pay the correct rebates, or offer the correct discounted pricing. Changes to the price reporting or rebate requirements of these programs would affect our obligations to pay rebates or offer discounts. For example, the removal of the current statutory 100% of Average Manufacturer Price per-unit cap on Medicaid rebate liability for single source and innovator multiple source drugs, effective as of January 1, 2024, under the American Rescue Plan Act of 2021 may affect the amount of rebates paid on prescription drugs under Medicaid and the prices that are required to be charged to covered entities under the 340B Drug Discount Program. Additionally, the Inflation Reduction Act requires manufacturers to pay rebates for Medicare Part B and Part D drugs with prices that increase faster than the rate of inflation. Responding to current and future changes to these and other Medicaid Drug Rebate Program requirements may reduce our net revenues and the complexity of compliance, will be time-consuming, and could have a material adverse effect on our results of operations.

If our processes and systems are not compliant with regulatory requirements, we could be subject to restrictions on marketing our products or could be delayed in submitting regulatory filings seeking approvals for our product candidates.

We have a number of regulated processes and systems that are required both prior to and following approval of our drugs and product candidates. These processes and systems are subject to continual review and periodic inspection by the FDA and other regulatory bodies. In addition, the clinical research organizations and other third parties that we work with in our non-clinical studies and clinical trials and our oversight of such parties are subject to similar reviews and periodic inspection by the FDA and other regulatory bodies. If compliance issues are identified at any point in the development and approval process, we may experience delays in filing for regulatory approval for our product candidates, or delays in obtaining regulatory approval after filing, if at all. Any later discovery of previously unknown problems or safety issues with approved drugs or manufacturing processes, or failure to comply with regulatory requirements, may result in restrictions on such drugs

or manufacturing processes, withdrawal of drugs from the market, the imposition of civil or criminal penalties or a refusal by the FDA and/or other regulatory bodies to approve pending applications for marketing approval of new drugs or supplements to approved applications, any of which could have a material adverse effect on our business. In addition, we are party to agreements that transfer responsibility for complying with specified regulatory requirements, such as filing and maintenance of marketing authorizations and safety reporting or compliance with manufacturing requirements, to our collaborators and third-party manufacturers. If our collaborators or third-party manufacturers do not fulfill these regulatory obligations, any drugs for which we or they obtain approval may be subject to later restrictions on manufacturing or sale, which could have a material adverse effect on our business.

We are subject to various and evolving laws and regulations governing the privacy and security of personal data, and our failure to comply could adversely affect our business, result in fines and/or criminal penalties, and damage our reputation.

We are subject to data privacy and security laws and regulations in various jurisdictions that apply to the collection, storage, use, sharing, and security of personal data, including health information, and impose significant compliance obligations. In addition, numerous other federal and state laws, including state security breach notification laws, state health information privacy laws and federal and state consumer protection laws, govern the collection, use, disclosure and security of personal information. The legislative and regulatory landscape for privacy and data protection continues to evolve, and there has been an increasing focus on privacy and data protection issues with the potential to affect our business.

For example, the E.U. General Data Protection Regulation ("GDPR") went into effect in 2018 and has imposed new obligations on us with respect to our processing of personal data and the cross-border transfer of such data, including higher standards of obtaining consent, more robust transparency requirements, data breach notification requirements, requirements for contractual language with our data processors, and stronger individual data rights. Different E.U. member states have interpreted the GDPR differently and many have imposed additional requirements, which add to the complexity of processing personal data in the E.U. The GDPR also imposes strict rules on the transfer of personal data to countries outside the E.U., including the U.S. and the U.K., and permits data protection authorities to impose large penalties for violations of the GDPR. The GDPR rules related to cross border data transfers continue to evolve based on E.U. court decisions and regulator guidance, which presents certain practical challenges to compliance. Regulators also continue to focus enforcement efforts on behavioral advertising and other online tracking technologies commonly used by companies. Compliance with these evolving rules is challenging, as country specific guidance and rules are continually changing and limited alternatives currently exist in the market. Compliance with the GDPR is a rigorous and time-intensive process that may increase our cost of doing business or require us to change our business practices, and despite those efforts, there is a risk that we may be subject to fines and penalties, litigation, and reputational harm in connection with any activities falling within the scope of the GDPR.

In the U.S., California has passed the California Consumer Privacy Act (the "CCPA"), which went into effect on January 1, 2020. In November 2020, California also passed the California Privacy Rights Act (the "CPRA"), which expands and builds upon the consumer privacy rights of the CCPA. The CPRA came into effect January 1, 2023. Certain other states have also enacted legislation governing the protection of personal data and several other states and the federal government are actively considering similar proposed legislation. Additionally, Brazil passed the General Data Protection Law, which went into effect in August 2020. While we continue to address the implications of the new data privacy regulations, data privacy remains an evolving landscape at both the domestic and international level, with new regulations coming into effect and continued legal challenges. Each law is also subject to various interpretations by courts and regulatory agencies, creating even more uncertainty. While we have a global privacy program that addresses such laws and regulations, our efforts to comply with the evolving data protection rules may be unsuccessful.

We must devote significant resources to understanding and complying with the changing landscape in this area. Failure to comply with data protection laws may expose us to risk of enforcement actions taken by data protection authorities, private rights of action in some jurisdictions, and potential significant penalties if we are found to be non-compliant. Failure to comply with the GDPR and applicable national data protection laws of European Economic Area member states could lead to fines of up to €20,000,000 or up to 4% of the total worldwide annual revenue of the preceding financial year, whichever is higher. Some of these laws and regulations also carry the possibility of criminal sanctions. For example, while we are not directly subject to the Health Insurance Portability and Accountability Act of 1996, as amended by the Health Information Technology for Economic and Clinical Health Act ("HIPAA"), we could be subject to penalties, including criminal penalties if we knowingly obtain or disclose individually identifiable health information from a HIPAA-covered health care provider or research institution that has not complied with HIPAA's requirements for disclosing such information. In addition, the

commercialization of cell and gene therapies requires the collection and processing of a greater amount of personal data than traditional therapies, potentially increasing risk. Furthermore, the number of government investigations related to data security incidents and privacy violations continue to increase and government investigations typically require significant resources and generate negative publicity, which could harm our business and our reputation.

The COVID-19 pandemic has added further complexity to the processing of personal data. For example, safety measures and government health regulations intended to protect our employees, contractors, and other visitors to our sites may require the collection of certain personal data. Although we are focused on ensuring that personal data is properly protected, our efforts may be unsuccessful and we could unintentionally be subject to unauthorized access or disclosure of such personal data.

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 and development efforts involve the regulated use of hazardous materials, chemicals, and various controlled and radioactive compounds. Although we believe that our safety procedures for handling and disposing of these materials comply with the standards prescribed by state, federal and foreign regulations, the risk of loss of, or 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 also are 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 biohazardous materials. Although we maintain workers' compensation insurance to cover us for costs 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 maintain insurance to cover pollution conditions or other extraordinary or unanticipated events relating to our use and disposal of hazardous materials that we believe is appropriate based on the small amount of hazardous materials we generate. 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.

Risks Related to Business Development Activities

Our ability to execute on our long-term strategy depends in part on our ability to engage in transactions and collaborations with other entities that add to our pipeline or provide us with new commercial opportunities.

To achieve our long-term business objectives, we seek to license or acquire products, product candidates and other technologies that have the potential to complement our ongoing research and development efforts, access emerging technologies and license or acquire pipeline assets. These transactions may be similar to prior transactions, may be structured differently than prior transactions, or may involve larger transactions or later-stage assets. We have faced and will continue to face significant competition for the acquisition of rights to these types of products, product candidates and other technologies from a variety of other companies, some of which have significantly more financial resources and experience in business development activities than we have. In addition, non-profit organizations may be willing to provide capital to the companies that control additional products, product candidates or technologies, which may provide incentives for companies to advance these products, product candidates or technologies independently. Also, the cost of acquiring, in-licensing or otherwise obtaining rights to such products, product candidates or other technologies has grown dramatically in recent years and may be at levels that we cannot afford or that we believe are not justified by market potential. As a result, we may not be able to acquire, in-license or otherwise obtain rights to additional products, product candidates or other technologies on acceptable terms or at all.

We may not realize the anticipated benefits of acquisitions of businesses or technologies, and the integration following any such acquisition may disrupt our business and management.

Effectively integrating acquired businesses, technologies and exclusive licenses is challenging. We may not realize the benefits anticipated from our external innovation transactions, such as our acquisitions of Semma, Exonics and ViaCyte and the exclusive licenses acquired from CRISPR and Moderna. Achieving the anticipated benefits of any transaction and successfully integrating acquired businesses or technologies involves a number of risks, including:

- failure to successfully develop and commercialize the acquired products, product candidates or technologies or to achieve other strategic objectives;

- delays or inability to progress preclinical programs into clinical development or unfavorable data from clinical trials evaluating the acquired or licensed product or product candidates;
- difficulty in integrating the products, product candidates, technologies, business operations and personnel of an acquired asset or company;
- disruption of our ongoing business and distraction of our management and employees from daily operations or other opportunities and challenges;
- the potential loss of key employees of an acquired company;
- entry into markets in which we have no or limited direct prior experience or where competitors in such markets have stronger market positions;
- potential failure of the due diligence processes to identify significant problems, liabilities or challenges of an acquired company, or acquired or licensed products, product candidate or technology, including but not limited to, problems, liabilities or challenges with respect to intellectual property, clinical or non-clinical data, safety, accounting practices, employee, or third-party relations and other known and unknown liabilities;
- liability for activities of the acquired company or licensor before the acquisition or license, including intellectual property infringement claims, violations of laws, commercial disputes, tax liabilities, and other known and unknown liabilities;
- exposure to litigation or other claims in connection with, or inheritance of claims or litigation risk as a result of an acquisition or license, including but not limited to, claims from terminated employees, customers, former equity holders or other third parties; and
- difficulties in the integration of the acquired company's departments, systems, including accounting, human resource and other administrative systems, technologies, books and records, and procedures, as well as in maintaining uniform standards, controls, including internal control over financial reporting required by the Sarbanes-Oxley Act of 2002 and related procedures and policies.

Acquisitions, licensing arrangements and other strategic transactions are inherently risky, and ultimately, if we do not complete an announced acquisition, collaboration or strategic transaction or integrate an acquired or licensed asset, business or technology successfully and in a timely manner, we may not realize the anticipated benefits of the strategic transaction.

We may later incur impairment charges related to assets acquired in any such transaction. Even if we achieve the long-term benefits associated with our strategic transactions, our expenses and short-term costs may increase materially and adversely affect our liquidity and short-term net income. Future strategic transactions could result in increased operating expenses, potentially dilutive issuances of equity securities, the incurrence of debt, the creation of contingent liabilities, impairment expenses related to goodwill, or impairment or amortization expenses related to other intangible assets, all of which could harm our financial condition.

We face risks in connection with existing and future collaborations with respect to the development, manufacture and commercialization of our products and product candidates.

The risks that we face in connection with our current collaborations, including CRISPR and Entrada, and any future collaborations, include the following:

- Our collaborators may change the focus of their development and commercialization efforts or may have insufficient resources or expertise to effectively develop, manufacture or commercialize our product candidates.
- The ability of some of our therapies to reach their potential could be limited if collaborators are unable to effectively develop, manufacture or commercialize these therapies or product candidates or decrease or fail to increase development or commercialization efforts related to those therapies or product candidates. Our collaboration agreements allocate development, manufacturing and commercialization responsibilities between us and our collaborators and provide our collaborators with a level of discretion in determining the amount and timing of efforts and resources that they will apply to these collaborations.

- Our collaborators may have limited experience in developing, manufacturing and commercializing therapies, either generally, or in the specific therapeutic area.
- Collaboration agreements may have the effect of limiting the areas of research and development that we may pursue, either alone or in collaboration with third parties.
- Collaborators may develop and commercialize, either alone or with others, drugs that are similar to or competitive with the products or product candidates that are the subject of their collaborations with us.
- Disagreements with collaborators, including disagreements over proprietary rights, contract interpretation or the preferred course of development, might cause delays or termination of the research, development or commercialization of product candidates, might lead to additional responsibilities or costs for us with respect to product candidates, or might result in litigation or arbitration. Any such disagreements would divert management attention and resources and would be time-consuming and expensive.
- Collaborators may not properly maintain or defend our intellectual property rights or may use our proprietary information in such a way as to invite litigation that could jeopardize or invalidate our intellectual property or proprietary information or expose us to potential litigation.
- Collaborators may infringe the intellectual property rights of third parties, which may expose us to litigation and potential liability.
- Investigations and/or compliance or enforcement actions against a collaborator, which may expose us to indirect liability as a result of our partnership with such collaborator.
- Our collaboration agreements are subject to termination under various circumstances.
- We may be unable to control the resources our collaborators devote to our programs, products or product candidates, and the priorities and strategic objectives of our collaborators may not align precisely with ours.

Additionally, if a collaborator were to be involved in a business combination with a third party, it might de-emphasize or terminate the development or commercialization of any product candidate licensed to it by us. If one of our collaborators terminates its agreement with us, we may find it more difficult to attract new collaborators and our perception in the business and financial communities could be harmed.

We may not be able to attract collaborators or external funding for the development and commercialization of certain of our product candidates.

As part of our ongoing strategy, we may seek additional collaborative arrangements or external funding for certain of our development programs and/or seek to expand existing collaborations to cover additional commercialization and/or development activities. We have a number of research programs and clinical development programs, some of which are being developed in collaboration with a third party. At any time, we may determine that to continue development of a product candidate or program or successfully commercialize a drug we need to identify a collaborator or amend or expand an existing collaboration.

Whether we reach a definitive agreement for a collaboration will depend, among other things, upon our assessment of the collaborator's resources and expertise, the terms and conditions of the proposed collaboration and the proposed collaborator's evaluation of a number of factors. Those factors may include the design or results of clinical trials, the likelihood of approval by the FDA, EMA or other regulatory authorities, the potential market for the subject product candidate, the costs and complexities of manufacturing and delivering such product candidate to patients, the potential of competing products, the existence of uncertainty with respect to our ownership of the applicable intellectual property, which can exist if there is a challenge to such ownership without regard to the merits of the challenge, and industry and market conditions generally. Potentially, and depending on the circumstances, we may desire that a collaborator either agree to fund portions of a drug development program led by us, or agree to provide all of the funding and directly lead the development and commercialization of a program. No assurance can be given that any efforts we make to seek additional collaborative arrangements will be successfully completed on a timely basis or at all. If we elect to fund and undertake development or commercialization activities on our own, we may need to obtain additional expertise and additional capital, which may not be available to us on acceptable terms or at all. If we are unable to enter into acceptable collaborative relationships, one or more

of our development programs could be delayed or terminated and the possibility of our receiving a return on our investment in the program could be impaired.

Risks Related to Supply, Manufacturing and Reliance on Third Parties

We depend on third-party manufacturers and our internal capabilities to manufacture our products and the materials we require for our clinical trials. We may not be able to maintain our third-party relationships and could experience supply disruptions outside of our control.

We rely on a worldwide network of third-party manufacturers and our internal capabilities, including our own manufacturing facilities in Boston, to manufacture product candidates for clinical trials as well as our medicines for commercial use. We could be subject to significant supply interruptions as a result of disruptions to third party or our internal manufacturing capabilities. Our supply chain for sourcing raw materials and manufacturing drug product ready for distribution, including obtaining necessary supplies, is a multi-step international endeavor. Third-party contract manufacturers, including some in China, perform different parts of our manufacturing process. Contract manufacturers may supply us with raw materials, convert these raw materials into drug substance and/or convert the drug substance into final dosage form. Third parties are used for packaging, warehousing and distribution of products. In cell and genetic therapies, third parties also will be used to both manufacture and deliver our therapies, which requires significant investment by us to secure capacity at third parties with expertise to meet our requirements. This capacity may be limited by the number of other clinical trials and commercial manufacturing ongoing for other companies seeking similar support.

If third parties are unwilling or unable to meet our requirements, including as a result of the COVID-19 pandemic or because of their own supply or capacity issues, we could experience supply disruptions outside of our control. Additionally, manufacturing facilities, both foreign and domestic, are subject to inspections by the FDA and other U.S. and foreign government authorities. Although we actively engage with regulatory authorities, the timing of regulatory approvals for each of these facilities may be delayed for a variety of reasons, including as a result of the COVID-19 pandemic. In addition, we and the third parties with whom we engage are required to maintain compliance with quality regulations globally. An inability to maintain compliance with such regulations, including cGMP requirements, could cause significant disruptions to our business and operations.

Additionally, establishing, managing and expanding our global supply chain requires a significant financial commitment and the creation and maintenance of our numerous third-party contractual relationships. Although we attempt to manage the business relationships with companies in our supply chain, we could be subject to supply disruptions outside of our control. In addition, we may not be able to agree on contractual terms with third parties as needed for manufacturing of our products.

Supply disruptions may result from a number of factors, including shortages in product raw materials, labor or technical difficulties, regulatory inspections or restrictions, shipping or customs delays, general global supply chain disruptions, or any other performance failure by us or any third-party manufacturer on which we rely. We may also experience supply disruptions if regulatory agencies are unable to inspect the manufacturing facilities on which we rely. Any such disruptions could disrupt sales of our products and/or the timing or advancement of our clinical trials.

While we have developed internal capabilities to supply product candidates for use in our clinical trials as well as our medicines for commercial sale, a majority of the manufacturing steps needed to produce our medicines, product candidates, and drug products are performed through a third-party manufacturing network. We expect that we will continue to rely on third parties to meet our commercial supply needs and a significant portion of our clinical supply needs for the foreseeable future.

If we or our third-party manufacturers become unable or unwilling to continue manufacturing product and we are not able to promptly identify another manufacturer, we could experience a disruption in the commercial supply of our then-marketed medicines, which would have a significant effect on patients, our business, and our product revenues. Similarly, a disruption in the clinical supply of product candidates could delay the completion of clinical trials and affect timelines for regulatory filings. We have a limited number of critical steps in our manufacturing process that are single sourced, including for commercialized products. To ensure the stability of our supply chains, we continue to develop alternatives for our manufacturing processes. However, there can be no assurance that we will be able to establish and maintain additional manufacturers or capacity for all of our product candidates and products on a timely basis or at all.

In the course of providing its services, a contract manufacturer may develop process technology related to the

manufacture of our products or product candidates that the manufacturer owns, either independently or jointly with us. This would increase our reliance on that manufacturer or require us to obtain a license from that manufacturer to have our products or product candidates manufactured by other suppliers utilizing the same process.

We rely on third parties to conduct pre-clinical work, clinical trials and other activities, and those third parties may not perform satisfactorily, including failing to meet established deadlines for the completion of such studies and/or trials or failing to satisfy regulatory requirements.

We rely on third parties such as CROs to help manage certain pre-clinical work and our clinical trials and on medical institutions, clinical investigators, and clinical research organizations such as the Therapeutic Development Network, which is primarily funded by the Cystic Fibrosis Foundation, to assist in the design and review of, and to conduct our clinical trials, including enrolling qualified patients. In addition, we engage third party contractors to support numerous other research, commercial and administrative activities. Our reliance on these third parties for clinical development activities reduces our control over these activities but does not relieve us of our responsibilities. For example, we remain responsible for ensuring that each of our clinical trials is conducted in accordance with the general investigational plan and protocols for the clinical trial. Moreover, the FDA requires us to comply with standards, commonly referred to as good laboratory practices and good clinical practices, for conducting, recording and reporting the results of pre-clinical and clinical trials to assure that data and reported results are credible and accurate and that the rights, integrity and confidentiality of trial participants are protected. Such standards, particularly with respect to newer cell and genetic therapies, will continue to evolve and subject us and third parties to new or changing requirements.

If these third parties do not successfully carry out their contractual duties or meet expected deadlines, we may be required to replace them. Although we believe that there are a number of other third-party contractors we could engage to continue the activities, it may result in a delay of the affected clinical trial, drug development program or applicable activity. If clinical trials are not conducted in accordance with our contractual expectations or regulatory requirements, action by regulatory authorities might significantly and adversely affect the conduct or progress of these clinical trials or in specific circumstances might result in a requirement that a clinical trial be redone. Accordingly, our efforts to obtain regulatory approvals for and commercialize our product candidates could be delayed. In addition, failure of any third-party contractor to conduct activities in accordance with our expectations, including as a result of COVID-19, could adversely affect the relevant research, development, commercial or administrative activity.

Risks Related to Intellectual Property

If our patents do not protect our products or our products infringe third-party patents, we could be subject to litigation which could result in injunctions preventing us from selling our products or substantial liabilities.

We own and/or control numerous issued patents and pending patent applications in the U.S., as well as counterparts in other countries. Our success will depend, in significant part, on our ability to obtain and defend U.S. and foreign patents covering our products, their uses and our processes, to preserve our trade secrets and to operate without infringing the proprietary rights of third parties. We cannot be certain that any patents will issue from our pending patent applications or, even if patents issue or have issued, that the issued claims will provide us with adequate protection against competitive products or otherwise be commercially valuable.

Due to evolving legal standards relating to the patentability, validity, and enforceability of patents covering pharmaceutical and biotechnological inventions and the scope of claims made under these patents, our ability to obtain, maintain and enforce patents is uncertain and involves complex legal and factual questions. Recent patent reform legislation could increase the uncertainties and costs surrounding the prosecution of our patent applications and the enforcement or defense of our issued patents in the U.S. The Leahy-Smith America Invents Act (the “Leahy-Smith Act”), made a number of significant changes to U.S. patent law in 2011. These include provisions that affect the way patent applications are prosecuted and may also affect patent litigation. For example, the first to file provisions limit the rights of an inventor who is the first to invent an invention but is not the first to file an application claiming that invention. U.S. and foreign patent applications typically are maintained in confidence for a period of time after they initially are filed with the applicable patent office. Consequently, we cannot be certain that we were the first to invent, or the first to file patent applications on, our products or product candidates or their use. If a third party also has filed a U.S. patent application relating to our products or product candidates, their uses, or a similar invention, we may have to participate in legal or administrative proceedings to determine priority of invention. For applications governed by the Leahy-Smith Act, if a third-party has an earlier filed U.S. patent application relating to our products or product candidates, their uses, or a similar invention, we may be unable to obtain an

issued patent from our application.

The issuance of a patent is not conclusive as to its inventorship, scope, validity, or enforceability. Our patents may be challenged by third parties and certain of our patents have been challenged. This could result in the patent being deemed invalid, unenforceable or narrowed in scope, or the third party may circumvent any such issued patents. Also, our pending patent applications may not issue, and we may not receive any additional patents.

Our patents or patents we license might not contain claims that are sufficiently broad to prevent others from developing competing products. For instance, issued patents, or patents that may issue in the future, (i) relating to our small molecules may be limited to a particular molecule or molecules and may not cover similar molecules that have similar clinical properties, and (ii) relating to cell or genetic therapies may not cover similar technologies that would allow competitors to achieve similar results. Consequently, our competitors may independently develop competing products that do not infringe our patents or other intellectual property. In addition, CRISPR only has co-exclusive rights to the patent rights that protect the core CRISPR/Cas9 gene-editing technology.

The laws of many foreign jurisdictions do not protect intellectual property rights to the same extent as in the U.S. and many companies in our segment of the pharmaceutical industry have encountered significant difficulties in protecting and defending such rights in foreign jurisdictions. If we encounter such difficulties in protecting or are otherwise precluded from effectively protecting our intellectual property rights in foreign jurisdictions, our business could be substantially harmed.

Because of the extensive time required for the discovery, development, testing and regulatory review of product candidates, it is possible that a patent may expire before a product candidate can be commercialized, or a patent may expire or remain in effect for only a short period following commercialization of such product candidate. This would result in a minimal or non-existent period of patent exclusivity. If our product candidates are not commercialized significantly ahead of the expiration date of any applicable patent, or if we have no patent protection on such product candidates, then, to the extent available we would rely on other forms of exclusivity, such as data exclusivity or orphan drug exclusivity.

Uncertainty over intellectual property in the pharmaceutical and biotechnology industry has been the source of litigation and other disputes that are inherently costly and unpredictable.

There is considerable uncertainty within our industry about the validity, scope, and enforceability of many issued patents in the U.S. and elsewhere in the world, and, to date, the law and practice remains in substantial flux both in the agencies that grant patents and in the courts. We cannot currently determine the ultimate scope and validity of patents which may be granted to third parties in the future or which patents might be asserted as being infringed by the manufacture, use and sale of our products.

There has been, and we expect that there may continue to be, significant litigation in the pharmaceutical industry regarding patents and other intellectual property rights. Litigation, arbitrations, administrative proceedings, and other legal actions with private parties and governmental authorities concerning patents and other intellectual property rights may be protracted, expensive, and distracting to management. Competitors may sue us as a way of delaying the introduction of our products or to remove our products from the market. Any litigation, including litigation related to Abbreviated New Drug Applications (“ANDA”), litigation related to 505(b)(2) applications, interference proceedings to determine priority of inventions, derivations proceedings, *inter partes* review, oppositions to patents in foreign countries, litigation against our collaborators or similar actions, may be costly and time consuming and could harm our business. We expect that litigation may be necessary in some instances to determine the validity and scope of certain of our proprietary rights. Litigation may be necessary in other instances to determine the validity, scope or non-infringement of certain patent rights claimed by third parties to be pertinent to the manufacture, use or sale of our products. Ultimately, the outcome of such litigation could adversely affect the validity and scope of our patent or other proprietary rights, hinder our ability to manufacture and market our products, or result in the assessment of significant monetary damages against us that may exceed amounts, if any, accrued in our consolidated financial statements.

On July 24, 2020, we filed a lawsuit against Sun Pharmaceutical Industries Limited (“Sun”) in the U.S. District Court for the District of Delaware alleging infringement of U.S. Patent No. 10,646,481 (the “’481 patent”). The lawsuit follows our receipt of a Notice Letter on June 11, 2020, advising that Sun had submitted an ANDA to the FDA seeking approval to manufacture and market a generic version of the 150 mg tablet of KALYDECO® in the U.S. The Notice Letter indicated that Sun submitted a “Paragraph IV” certification to the FDA in which Sun asserts that the ’481 patent is invalid or would not be infringed by Sun’s generic product. The ’481 patent, which expires on August 13, 2029, was issued on May 12, 2020, and

listed in the Orange Book with respect to KALYDECO® tablets on June 1, 2020. Sun does not appear to challenge our other U.S. patents covering KALYDECO tablets, the latest of which expires on August 5, 2027.

On July 13, 2021, we filed a lawsuit against Lupin Limited and Lupin Pharmaceuticals, Inc. (collectively, "Lupin") in the U.S. District Court for the District of Delaware alleging infringement of the '481 patent. The lawsuit follows our receipt of a Notice Letter on June 2, 2021 advising that Lupin had submitted an ANDA to the FDA seeking approval to manufacture and market a generic version of the 150 mg tablet of KALYDECO in the U.S. The Notice Letter indicated that Lupin submitted a "Paragraph IV" certification to the FDA in which Lupin asserts that the '481 patent is invalid or would not be infringed by Lupin's generic product. Lupin does not appear to challenge our other U.S. patents covering KALYDECO tablet.

On June 2, 2022, we filed a lawsuit against Aurobindo Pharma Limited ("Aurobindo"), in the U.S. District Court for the District of Delaware alleging infringement of the '481 patent. The lawsuit follows our receipt of a Notice Letter on April 21, 2022, advising that Aurobindo had submitted an ANDA to the FDA seeking approval to manufacture and market a generic version of the 150 mg tablet of KALYDECO in the U.S. The Notice Letter indicated that Aurobindo submitted a "Paragraph IV" certification to the FDA in which Aurobindo asserts that the '481 patent is invalid or would not be infringed by Aurobindo's generic product. Aurobindo does not appear to challenge our other U.S. patents covering KALYDECO® tablet. The lawsuits against Sun, Lupin, and Aurobindo described above regarding the 150mg tablet of KALYDECO and the '481 patent have been consolidated by the Delaware court. A scheduling order has been entered by the court and trial is set for February 2024. We intend to vigorously enforce our intellectual property rights relating to KALYDECO tablet and the '481 patent.

On July 22, 2022, we filed a lawsuit against Lupin in the U.S. District Court for the District of Delaware alleging the infringement of the '481 patent and the U.S. Patent Nos. 8,883,206 (the "'206 patent"), 10,272,046 (the "'046 patent"), and 11,147,770 (the "'770 patent"). The lawsuit follows our receipt of a Notice Letter on June 9, 2022, advising that Lupin had submitted an ANDA to the FDA seeking approval to manufacture and market a generic version of KALYDECO® granules in the U.S. The Notice Letter indicated that Lupin submitted a "Paragraph IV" certification to the FDA in which Lupin asserts that the '481 patent, the '206 patent, and the '046 patent are invalid or would not be infringed by Lupin's generic product. Other than the '770 patent, which was listed in the Orange Book on April 14, 2022, Lupin does not appear to challenge our other U.S. patents covering KALYDECO granules, the last of which expires on August 5, 2027. A scheduling order has been entered by the court and trial is set for September 2024. We intend to vigorously enforce its intellectual property rights relating to KALYDECO granules and the '481, '206, '046 and '770 patents.

CRISPR has licensed certain rights to a worldwide patent portfolio that covers various aspects of the CRISPR/Cas9 editing platform technology including, for example, compositions of matter and methods of use in targeting or cutting DNA from Dr. Emmanuelle Charpentier, one of the named inventors of this patent portfolio. The patent portfolio also has named inventors who assigned their rights to the CVC Group. For example, in connection with their collaboration, Novartis and Intellia Therapeutics, Inc. have reportedly obtained a license to this patent portfolio in certain fields. Both the CVC Group and the Broad Institute have obtained granted patents that purport to cover aspects of CRISPR/Cas9 editing platform technology. Patents and patent applications in this patent portfolio have been the subject of numerous contentious proceedings in the U.S., Europe, and other jurisdictions, including interference proceedings in the USPTO between the CVC Group and (separately) the Broad Institute, Sigma-Aldrich and ToolGen. On February 28, 2021, the USPTO issued a decision in Interference No. 106, 115, concluding that the Broad Institute invented certain applications of CRISPR/Cas9 technology in eukaryotic cells before the CVC Group. The CVC Group has appealed the decision to the U.S. Court of Appeals for the Federal Circuit. If the decision is upheld on appeal (including a potential subsequent appeal to the Supreme Court), the Broad Institute would maintain its granted patents directed to those applications CRISPR/Cas9 technology in eukaryotic cells, and the CVC Group's pending patent applications directed to that subject matter would not proceed to grant. We can give no assurances to the ultimate outcome of these proceedings or the disputes between the CVC Group and the Broad Institute, Sigma-Aldrich and ToolGen.

In addition to the Broad Institute, other third parties have filed patent applications claiming CRISPR/Cas9-related inventions and may allege that they invented one or more of the inventions claimed by the CVC Group. Thus, the USPTO may, in the future, declare an interference between certain CVC Group patent applications and one or more patent applications. The Broad Institute, as well as other third parties, could seek to assert its issued patents against us based on our CRISPR/Cas9-based activities, including commercialization. Defense of these claims, regardless of their merit, could involve substantial litigation expense and could result in a substantial diversion of management and other employee resources from our business. In the event of a successful claim of infringement against us, we may have to pay substantial damages, obtain

one or more licenses from third parties, pay royalties or redesign our infringing products, which may be impossible or require substantial time and monetary expenditure. In that event, we could be unable to further develop and commercialize exa-cel or other products that we may develop using the CRISPR/Cas9 technology we license from CRISPR.

To the extent that valid present or future third-party patents or other intellectual property rights cover our products, product candidates or technologies, we or our strategic collaborators may seek licenses or other agreements from the holders of such rights to avoid or settle legal claims. Such licenses may not be available on acceptable terms, which may hinder our ability to, or prevent us from being able to, manufacture and market our products. Payments under any licenses that we are able to obtain would reduce our profits derived from the covered products.

We may be subject to claims by third parties asserting that our employees or we have misappropriated their intellectual property, or claiming ownership of what we regard as our own intellectual property.

Many of our employees were previously employed at universities or other biotechnology or pharmaceutical companies, including our competitors or potential competitors. Although we try to ensure that our employees do not use the proprietary information or know-how of others in their work for us, we may be subject to claims that these employees or we have used or disclosed intellectual property, including trade secrets or other proprietary information, of any such employee's former employer. Litigation may be necessary to defend against these claims.

In addition, while it is our policy to require our employees and contractors who may be involved in the development of intellectual property to execute agreements assigning such intellectual property to us, we may be unsuccessful in executing such an agreement with each party who in fact develops intellectual property that we regard as our own. Our and their assignment agreements may not be self-executing or may be breached, and we may be forced to bring claims against third parties, or defend claims they may bring against us, to determine the ownership of what we regard as our intellectual property.

If we fail in prosecuting or defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights or personnel. Even if we are successful in prosecuting or defending against such claims, litigation could result in substantial costs and be a distraction to management.

Risks Related To Our Operations

A variety of risks associated with operating in foreign countries could materially adversely affect our business.

We have expanded our international operations over the past several years to market our CF medicines and expand our research and development capabilities. New laws and industry codes in the E.U. and elsewhere have expanded transparency requirements regarding payments and transfers of value to healthcare professionals, requirements surrounding patient-level clinical trial data, the protection of personal data and increased sanctions for violations. Collectively, our expansion and these new requirements are adding to our compliance costs and potentially exposes us to sanctions in the event of an infringement or failure to report in these jurisdictions. In addition, a significant portion of our commercial supply chain, including sourcing of raw materials and manufacturing, is located in China and the E.U. Consequently, we are, and will continue to be, subject to risks related to operating in foreign countries, including risks relating to intellectual property protections and business interruptions, including as a result of COVID-19. These risks are increased with respect to countries such as China that have substantially different local laws and business practices and weaker protections for intellectual property. Risks associated with operating a global biotechnology company include:

- differing regulatory requirements for drug approvals and regulation of approved drugs in foreign countries;
- varying reimbursement regimes and difficulties or the inability to obtain reimbursement for our products in foreign countries in a timely manner;
- differing patient treatment infrastructures, particularly since our business is focused on the treatment of serious diseases that affect relatively smaller numbers of patients and are typically prescribed by specialist physicians;
- collectability of accounts receivable;
- changes in tariffs, trade barriers, and regulatory requirements, the risks of which appear to have increased in the current political environment;

- economic weakness, including recession and inflation, or political instability in particular foreign economies and markets;
- differing levels of enforcement and/or recognition of contractual and intellectual property rights;
- complying with local laws and regulations, which can change significantly over time;
- foreign taxes, including withholding of payroll taxes;
- foreign currency fluctuations, which could result in reduced revenues or increased operating expenses, and other obligations incident to doing business or operating in another country;
- workforce uncertainty in countries where labor unrest is more common than in the U.S.;
- reliance on third-party vendors, distributors and suppliers;
- import and export licensing requirements, tariffs, and other trade and travel restrictions;
- global or regional public health emergencies that could affect our operations or business;
- production shortages resulting from any events affecting raw material supply or manufacturing capabilities abroad; and
- business interruptions resulting from geo-political actions, including war and terrorism.

Our revenues are subject to foreign exchange rate fluctuations due to the global nature of our operations. Although we have foreign currency forward contracts to hedge certain forecasted product revenues denominated in foreign currencies, our efforts to reduce currency exchange losses may not be successful. As a result, currency fluctuations among our reporting currency, the U.S. dollar, and the currencies in which we do business will affect our operating results, often in unpredictable ways.

In addition, our international operations are subject to regulation under U.S. law. For example, the FCPA prohibits U.S. companies and their representatives from offering, promising, authorizing or making payments to foreign officials for the purpose of obtaining or retaining business abroad. In many countries, the health care professionals we regularly interact with may meet the definition of a foreign government official for purposes of the FCPA. We also are subject to import/export control laws. Failure to comply with domestic or foreign laws could result in various adverse consequences, including the possible delay in approval or refusal to approve a product, recalls, seizures, withdrawal of an approved product from the market, the imposition of civil or criminal sanctions, the prosecution of executives overseeing our international operations and corresponding bad publicity and negative perception of our company in foreign countries.

If we fail to attract and retain skilled employees, our business could be materially harmed.

Due to the highly technical nature of our drug discovery and development activities, we require the services of highly qualified and trained scientists who have the skills necessary to conduct these activities. In addition, we need to attract and retain employees with experience in development, marketing and commercialization of medicines and therapies, including cell and genetic therapies. We have entered into employment agreements with some executives and provide stock-related compensation benefits to all of our key employees that vest over time and therefore induce them to remain with us. However, the employment agreements can be terminated by the executive on relatively short notice. The value to employees of stock-related benefits that vest over time can be significantly affected by movements in our stock price and business performance, and may, at any point in time, be insufficient to counteract more lucrative offers from other companies. We face intense competition for our personnel from our competitors and other companies throughout our industry, especially with respect to employees with expertise in cell or genetic therapies. We also experience competition for the hiring of scientific and clinical personnel from universities and research institutions. Moreover, the growth of local biotechnology companies and the expansion of major pharmaceutical companies into the Boston area has increased competition for the available pool of skilled employees, especially in technical fields. The high cost of living can make it difficult to attract employees to our global headquarters in Boston and our international headquarters in London. Current job market dynamics, caused in part by the effects of COVID-19 and other macro-level events, with many employers unable to fill existing openings at all levels of their organizations, could result in significant increases to our costs to recruit and retain employees. Challenges could adversely affect our operations and financial results if we do not have sufficient staff to perform necessary functions. In addition, the

available pool of skilled employees would be further reduced if immigration laws change in a manner that increases restrictions on immigration. Our ability to continue to commercialize our products and achieve our research and development objectives depends on our ability to respond effectively to these demands. If we are unable to hire and retain qualified personnel, there could be a material adverse effect on our business.

A breakdown or breach of our information technology systems could subject us to liability or interrupt the operation of our business.

We maintain and rely extensively on information technology systems and network infrastructures for the effective operation of our business. In the course of our business, we collect, store, and transmit confidential information (including personal information and intellectual property), and it is critical that we do so in a secure manner to maintain the confidentiality and integrity of such confidential information. A disruption, infiltration, or failure of our information technology systems or any of our data centers as a result of software or hardware malfunctions, computer viruses, cyber-attacks, employee theft or misuse, power disruptions, natural disasters, floods or accidents could cause breaches of data security and loss of critical data, which in turn could materially adversely affect our business and subject us to both private and governmental causes of action. While we have implemented security measures to minimize these risks to our data and information technology systems and have adopted a business continuity plan to deal with a disruption to our information technology systems, there can be no assurance that our efforts to protect our data and information systems will prevent breakdowns or breaches in our systems that could adversely affect our business. In addition, our liability insurance may not be sufficient in type or amount to cover us against claims related to security breaches, cyber-attacks or other related liabilities.

Cyber-attacks are increasing in their frequency, sophistication, and intensity, and are becoming increasingly difficult to detect. They are often carried out by well-resourced and skilled parties, including nation states, organized crime groups, “hacktivists” and employees or contractors acting carelessly or with malicious intent. Cyber-attacks include deployment of harmful malware and key loggers, ransomware, denial-of-service attacks, malicious websites, the use of social engineering, and other means to affect the confidentiality, integrity and availability of our technology systems and data. Cyber-attacks also include manufacturing, hardware or software supply chain attacks, which could cause a delay in the manufacturing of products or products produced for contract manufacturing or lead to a data privacy or security breach. Our key business partners face similar risks, and any security breach of their systems could adversely affect our security. In addition, our increased use of cloud technologies heightens these third party and other operational risks, and any failure by cloud or other technology service providers to adequately safeguard their systems and prevent cyber-attacks could disrupt our operations and result in misappropriation, corruption, or loss of confidential or propriety information. Risk of cyber-attack is increased with employees working remotely. Remote work increases the risk we may be vulnerable to cybersecurity-related events such as phishing attacks and other security threats.

We are subject to risks associated with COVID-19.

The COVID-19 pandemic resulted in global economic downturns, significant travel and work restrictions in many regions and put a significant strain on healthcare resources, among other impacts. Recovery from the economic and social disruptions of COVID-19 have been uneven. We are unable to predict the extent and timing of any improvement in overall conditions. COVID-19 may continue to impact our operations, the operations of our collaborators, third-party contractors and other entities, including governments, governmental agencies, and payors, and on the people with CF who take our medicines. In addition, we have seen some delays in enrollment in certain clinical trials, supply chain delays, and regulatory delays due to COVID-19.

We monitor local COVID-19 trends and government guidance for each of our site locations and utilize a site-specific approach to assess and permit employee access to our sites. There can be no assurance, however, that our sites will remain open, or whether we will be required to pause or delay enrollment and dosing at clinical trial sites. Any site closure, pause, or delay of a clinical trial could harm our operations and delay the development of our product candidates. In addition, even if sites or clinical trials are open for enrollment, COVID-19 may nevertheless impact clinical trial enrollment or participation, for example, due to suspension of in-person procedures required for enrollment, government shut-down orders, or decreased patient willingness to participate. COVID-19 may also impact uptake of our medicines generally and patient retention in clinical trials, potentially resulting in higher drop-out rates or missed visits, which may negatively affect the strength of our clinical trial data.

Health regulatory agencies globally may continue to experience disruptions in their operations as a result of COVID-19

or future public health emergencies. The FDA and comparable foreign regulatory agencies may have slower response times or lack resources to continue to monitor our clinical trials or to engage in other activities related to review of regulatory submissions in drug development. In response to the COVID-19 pandemic and the public health emergency declaration in the U.S., on March 10, 2020, the FDA announced its intention to temporarily postpone most inspections of foreign manufacturing facilities and products, and it subsequently postponed routine surveillance inspections of domestic manufacturing facilities and provided guidance regarding the conduct of clinical trials. In July 2021, the FDA stated that it had begun transitioning back to standard operations for domestic inspections, while continuing to prioritize mission-critical work for foreign inspections. In February 2022, the FDA announced it was resuming standard operation for all domestic inspections. By the end of 2022, the FDA had also resumed standard foreign inspections in most countries, though the frequency of foreign inspections had not yet returned to pre-pandemic levels. The FDA may not be able to maintain its current pace and further delays or setbacks are possible in the future. As a result, review, inspection, and other timelines for our product candidates may be materially delayed for an unknown period of time.

In the future, the economic impacts of COVID-19 could affect our business. While the ultimate impact of COVID-19 on our business is uncertain, a continued economic downturn could adversely affect our business directly or indirectly. It could affect the net prices for our products through changes in our payor mix as a result of increased unemployment in the U.S. or increased pressure on healthcare costs in the U.S. and around the world. Any negative impacts of COVID-19, alone or in combination with others, could exacerbate other risk factors discussed herein. The full extent to which COVID-19 will negatively affect our operations, financial performance, and stock price will depend on future developments that are highly uncertain and cannot be predicted.

If we fail to manage our operations effectively, our business may suffer.

We have expanded and are continuing to expand our global operations and capabilities, which has placed, and will continue to place, significant demands on our management and our operational, research and development and financial infrastructure. To effectively manage our business, we need to:

- implement and clearly communicate our corporate-wide strategies;
- enhance our operational and financial infrastructure, including our controls over records and information;
- enhance our operational, financial and management processes, including our cross-functional decision-making processes and our budget prioritization systems;
- train and manage our global employee base; and
- enhance our compliance and legal resources.

Our business has a substantial risk of product liability claims and other litigation liability.

We are or may be involved in various legal proceedings, including securities/shareholder matters and claims related to product liability, intellectual property, employment law, data privacy, and breach of contract. Such proceedings may involve claims for, or the possibility of, damages or fines and penalties involving substantial amounts of money or other relief, including but not limited to civil or criminal fines and penalties. If any of these legal proceedings were to result in an adverse outcome, it could have a material adverse effect on our business.

With respect to product liability and clinical trial risks, in the ordinary course of business we are subject to liability claims and lawsuits, including potential class actions, alleging that our products or product candidates have caused, or could cause, serious adverse events or other injury. We have product liability insurance and clinical trial insurance in amounts that we believe are adequate to cover this risk. However, our insurance may not provide adequate coverage against all potential liabilities. If a claim is brought against us, we might be required to pay legal and other expenses to defend the claim, as well as pay uncovered damage awards resulting from a claim brought successfully against us and these damages could be significant and have a material adverse effect on our financial condition. Furthermore, whether or not we are ultimately successful in defending any such claims, we might be required to direct significant financial and managerial resources to such defense and adverse publicity is likely to result.

If our facilities were to experience a catastrophic loss, our operations would be seriously harmed.

Most of our operations, including our research and development activities, are conducted in a limited number of facilities. If any of our major facilities were to experience a catastrophic loss, due to an earthquake, severe storms, fire or similar event, our operations could be seriously harmed. For example, our corporate headquarters, as well as additional leased space that we use for certain logistical and laboratory operations and manufacturing, are located in a flood zone along the Massachusetts coast. We have adopted a business continuity plan to address most crises. However, if we are unable to fully implement our business continuity plans, we may experience delays in recovery of data and/or an inability to perform vital corporate functions, which could result in a significant disruption in our research, development, manufacturing and/or commercial activities, large expenses to repair or replace the facility and/or the loss of critical data, which could have a material adverse effect on our business.

The use of social media platforms presents risks and challenges.

Social media is being used by third parties to communicate about our products and product candidates and the diseases our therapies are designed to treat. We believe that members of the CF community may be more active on social media as compared to other patient populations due to the demographics of this patient population. Social media practices in the pharmaceutical and biotechnology industries are evolving, which creates uncertainty and risk of noncompliance with regulations applicable to our business. For example, patients may use social media platforms to comment on the effectiveness of, or adverse experiences with, a product or a product candidate, which could result in reporting obligations. In addition, our employees may engage on social media in ways that may not comply with legal or regulatory requirements, which may give rise to liability, lead to the loss of trade secrets and other intellectual property, or result in public disclosure of protected personal information. There is a risk of inappropriate disclosure of sensitive information or negative or inaccurate posts or comments about us on any social networking website. Certain data protection regulations, such as the GDPR, apply to personal data contained on social media. If any of these events were to occur or we otherwise fail to comply with applicable regulations, we could incur liability, face regulatory actions or incur harm to our business, including damage to our reputation.

Risks Related to Financial Results and Holding Our Common Stock

Our stock price may fluctuate.

Market prices for securities of companies such as ours are highly volatile. From January 1, 2022 to December 31, 2022, our common stock traded between $214.66 and $324.75 per share. The market for our stock, like that of other companies in the biotechnology industry, has experienced significant price and volume fluctuations. The future market price of our securities could be significantly and adversely affected by factors such as:

- the information contained in our quarterly earnings releases, including updates regarding our commercialized products or our product candidates, our net product revenues and operating expenses for completed periods and financial guidance regarding future periods;
- announcements of FDA actions with respect to our therapies or those of our competitors, or regulatory filings for our therapies or those of our competitors, or announcements of interim or final results of clinical trials or nonclinical studies relating to our therapies or those of our competitors;
- developments in domestic and international governmental policy or regulation, for example, relating to drug pricing and tax reform;
- technological innovations or the introduction of new drugs by our competitors;
- government regulatory action;
- public concern as to the safety of drugs developed by us or our competitors;
- developments in patent or other intellectual property rights or announcements relating to these matters;
- information disclosed by third parties regarding our business or products;

- developments relating specifically to other companies and market conditions for pharmaceutical and biotechnology stocks or stocks in general;
- business development, capital structuring or financing activities; and
- general worldwide or national economic, political and capital market conditions, including as a result of the COVID-19 pandemic, inflation and rapid fluctuations in interest rates.

Following periods of volatility in the market price of a company's securities, stockholder derivative lawsuits and securities class action litigation are common. Such litigation, if instituted against us or our officers and directors, could result in substantial costs and a diversion of management's attention and resources.

Our effective tax rate fluctuates, and changes in tax laws, regulations and treaties, unfavorable resolution to the tax positions we have taken or exposure to additional income tax liabilities could have a material impact on our future taxable income.

Our effective tax rate is derived from a combination of applicable tax rates in the various places that we operate globally. Our effective tax rate may be different than experienced in the past due to numerous factors, including changes in the mix of our profitability from country to country, tax authority examinations/audits of our tax filings, adjustments to the value of our uncertain tax positions, changes in accounting for income taxes, and changes in tax laws or modifications of treaties in various jurisdictions. Any of these factors could cause us to experience an effective tax rate that is significantly different from previous periods or our current expectations.

On December 12, 2022, E.U. member states reached an agreement to implement the minimum tax component ("Pillar Two") of the Organization for Economic Co-operation and Development's (the "OECD's"), global international tax reform initiative. It is expected that E.U. member states will implement Pillar Two for tax years beginning after December 31, 2023. In addition, the U.K. has independently released draft legislation to introduce the OECD's Pillar Two reforms into U.K. law. If implemented, Pillar Two could result in changes in tax laws in jurisdictions in which we do business and adversely affect our provision for income taxes and our current rate.

We are subject to ongoing tax audits in various jurisdictions, and local tax authorities may disagree with certain positions we have taken and assess additional taxes. We regularly assess the probable outcomes of these audits to determine the appropriateness of our tax provision, and we have established contingency reserves for material tax exposures. However, there can be no assurance that we will accurately predict the outcomes of these disputes or other tax audits or that issues raised by tax authorities will be resolved at a financial cost that does not exceed our related reserves and the actual outcomes of these disputes and other tax audits could have a material impact on our results of operations or financial condition.

Our quarterly operating results are subject to significant fluctuation.

Our operating results have fluctuated from quarter to quarter in the past, and we expect that they will continue to do so in the future. Our revenues are primarily dependent on the amount of net product revenues from sales of our CF medicines. Our total net product revenues could vary on a quarterly basis based on, among other factors, the timing of orders from our significant customers. Additional factors that have caused quarterly fluctuations to our operating results in recent years include variable amounts of revenues, expenses resulting from our significant investments in research and development and commercialization activities, changes in the fair value of our strategic investments, derivative instruments and contingent consideration liabilities, charges for excess and obsolete inventories, interest income, interest expenses and our provision for income taxes. Our revenues also are subject to foreign exchange rate fluctuations due to the global nature of our operations. Although we have foreign currency forward contracts to hedge forecasted product revenues denominated in foreign currencies, our efforts to reduce currency exchange losses may not be successful. As a result, currency fluctuations among our reporting currency, the U.S. dollar, and the currencies in which we do business may affect our operating results, often in unpredictable ways. Our quarterly results also could be materially affected by significant charges, which may or may not be similar to charges we have experienced in the past. Most of our operating expenses relate to our research and development activities, do not vary directly with the amount of revenues and are difficult to adjust in the short term. As a result, if revenues in a particular quarter are below expectations, we are unlikely to reduce operating expenses proportionately for that quarter. These examples are only illustrative and other risks, including those discussed in these "Risk Factors," could also cause fluctuations in our reported financial results. Our operating results during any one period do not necessarily suggest the results of future periods.

We expect that results from our clinical development activities and the clinical development activities of our competitors will continue to be released periodically, and may result in significant volatility in the price of our common stock.

Any new information regarding our products and product candidates or competitive products or potentially competitive product candidates can substantially affect investors' perceptions regarding our future prospects. We, our collaborators, and our competitors periodically provide updates regarding drug development programs, typically through press releases, conference calls and presentations at medical conferences. These periodic updates often include interim or final results from clinical trials conducted by us or our competitors and/or information about our or our competitors' expectations regarding regulatory filings and submissions as well as future clinical development of our products or product candidates, competitive products or potentially competitive product candidates. The timing of the release of information by us regarding our drug development programs is often beyond our control and is influenced by the timing of receipt of data from our clinical trials and by the general preference among pharmaceutical companies to disclose clinical data during medical conferences. In addition, the information disclosed about our clinical trials, or our competitors' clinical trials, may be based on interim rather than final data that may involve interpretation difficulties and may in any event not accurately predict final results. The release of such information may result in volatility in the price of our common stock.

General Risk Factors

We may need to raise additional capital that may not be available.

We may need to raise additional capital in the future. Any potential public offering, private placement or debt financing may or may not be similar to the transactions that we entered into in the past. Any debt financing may be on terms that, among other things, include conversion features that could result in dilution to our then-existing security holders and restrict our ability to pay interest and dividends—although we do not intend to pay dividends for the foreseeable future. Any equity financings would result in dilution to our then-existing security holders. If adequate funds are not available on acceptable terms, or at all, we may be required to curtail significantly or discontinue one or more of our research, drug discovery or development programs, including clinical trials, incur significant cash exit costs, or attempt to obtain funds through arrangements with collaborators or others that may require us to relinquish rights to certain of our technologies, products or product candidates. Based on many factors, including general economic conditions, additional financing may not be available on acceptable terms, if at all.

Future indebtedness could materially and adversely affect our financial condition, and the terms of our credit agreements impose restrictions on our business, reducing our operational flexibility and creating default risks.

In July 2022, we entered into a credit agreement providing for a $500.0 million revolving credit facility and terminated an existing $500.0 million credit agreement entered into in 2019. In September 2022, our $2.0 billion credit agreement that was entered into in 2020 expired in accordance with its terms. Subject to certain conditions, our current credit agreement provides that we may request the borrowing capacity be increased by an additional $500.0 million for a total of $1.0 billion. If we borrow under our current credit agreement or any future credit agreements, such indebtedness could have important consequences to our business, including increasing our vulnerability to general adverse financial, business, economic and industry conditions, as well as other factors that are beyond our control. The credit agreement requires that we comply with certain financial covenants, including a consolidated leverage ratio covenant. Further, the credit agreement includes negative covenants, subject to exceptions, restricting or limiting our ability and the ability of our subsidiaries to, among other things, incur additional indebtedness, grant liens, engage in certain investment, acquisition and disposition transactions, and enter into transactions with affiliates. As a result, we may be restricted from engaging in business activities that may otherwise improve our business. Failure to comply with the covenants could result in an event of default that could trigger acceleration of our indebtedness, which would require us to repay all amounts owed under the credit agreements and/or our finance leases and could have a material adverse effect on our business. Additionally, our obligations under the credit agreement are unconditionally guaranteed by certain of our domestic subsidiaries.

Issuances of additional shares of our common stock could cause the price of our common stock to decline.

As of December 31, 2022, we had 257.0 million shares of common stock issued and outstanding. As of December 31, 2022, we also had 2.9 million unvested restricted stock units ("RSUs"), 1.2 million unvested performance stock units ("PSUs"), and outstanding options to purchase 2.5 million shares of common stock with a weighted-average exercise price of $146.11 per share.

The majority of our unvested RSUs are likely to vest based on our employees' continued employment. The number of PSUs that vest is dependent on a potential range of shares issuable pursuant to certain financial and non-financial milestones, and our employees' continued employment. Outstanding vested options are likely to be exercised if the market price of our common stock exceeds the applicable exercise price. In the future, we expect to issue a limited number of additional options to our directors.

In addition, we may issue additional common stock or restricted securities in the future as part of financing activities or business development activities and any such issuances may have a dilutive effect on our then-existing shareholders. Sales of substantial amounts of our common stock in the open market, or the availability of such shares for sale, could adversely affect the price of our common stock. The issuance of restricted common stock or common stock upon exercise of any outstanding options would be dilutive, and may cause the market price for a share of our common stock to decline.

There can be no assurance that we will repurchase shares of common stock or that we will repurchase shares at favorable prices.

In February 2023, our Board of Directors approved a share repurchase program (the "2023 Share Repurchase Program") pursuant to which we are authorized to repurchase up to $3.0 billion of our common stock. Our stock repurchases will depend upon, among other factors, our cash balances and potential future capital requirements, results of operations, financial condition, and other factors that we may deem relevant. We can provide no assurance that we will repurchase stock at favorable prices, if at all.

We have adopted provisions in our articles of incorporation and by-laws and are subject to Massachusetts corporate laws that may frustrate any attempt to remove or replace members of our board or to effectuate certain types of business combinations involving Vertex.

Provisions of our articles of incorporation, by-laws and Massachusetts state laws may frustrate any attempt to remove or replace members of our current Board of Directors and may discourage certain types of business combinations involving Vertex. Our by-laws grant the directors a right to adjourn any meetings of shareholders prior to the time the meeting has been convened. We may issue shares of any class or series of preferred stock in the future without shareholder approval and upon such terms as our Board of Directors may determine. The rights of the holders of common stock will be subject to, and may be adversely affected by, the rights of the holders of any class or series of preferred stock that may be issued in the future. Massachusetts state law also prohibits us from engaging in specified business combinations with an interested stockholder unless the combination is approved or consummated in a prescribed manner, and prohibits voting by any shareholder who acquires 20% or more of the outstanding voting stock without shareholder approval. As a result, shareholders or other parties may find it difficult to remove or replace our directors or to effectuate certain types of business combinations involving Vertex.

SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K, including the descriptions of our Business set forth in Part I, Item 1, our Risk Factors set forth in Part I, Item 1A, and our Management's Discussion and Analysis of Financial Condition and Results of Operations set forth in Part II, Item 7, contains forward-looking statements. Forward-looking statements are not purely historical and may be accompanied by words such as "anticipates," "may," "forecasts," "expects," "intends," "plans," "potentially," "believes," "seeks," "estimates," and other words and terms of similar meaning. Such statements may relate to:

- our expectations regarding the amount of, timing of, and trends with respect to our financial performance, including revenues, costs and expenses, and other gains and losses;
- our expectations regarding clinical trials, including expectations for patient enrollment, development timelines, the expected timing of data from our ongoing and planned clinical trials, and regulatory authority filings and other submissions for our therapies;
- our ability to maintain and obtain adequate reimbursement for our products, our ability to launch, commercialize and market our products or any of our other therapies for which we obtain regulatory approval and our ability to obtain label expansions for existing therapies;
- our expectations regarding our ability to continue to grow our CF business by increasing the number of people with CF eligible and able to receive our medicines and providing improved treatment options for people who are already eligible for one of our medicines;

- the data that will be generated by ongoing and planned clinical trials and the ability to use that data to advance compounds, continue development or support regulatory filings;
- our beliefs regarding the support provided by clinical trials and preclinical and nonclinical studies of our therapies for further investigation, clinical trials or potential use as a treatment;
- our plans to continue investing in our research and development programs, including anticipated timelines for our programs, and our strategy to develop our pipeline programs, alone or with third party-collaborators;
- our beliefs regarding the approximate patient populations for the disease areas on which we focus;
- the potential benefits and therapeutic scope of our acquisitions and collaborations, including our acquisition of ViaCyte and its potential to accelerate development of our stem-cell based T1D programs;
- the establishment, development and maintenance of collaborative relationships, including potential milestone payments or other obligations;
- potential business development activities, including the identification of potential collaborative partners or acquisition targets;
- our ability to expand and protect our intellectual property portfolio and otherwise maintain exclusive rights to products;
- potential fluctuations in foreign currency exchange rates and the effectiveness of our foreign currency management program;
- our expectations regarding the amount of cash to generated by operations, our cash balance and expected generation and interest income;
- our expectations regarding our provision for or benefit from income taxes and the utilization of our deferred tax assets;
- our ability to use our research programs to identify and develop new product candidates to address serious diseases and significant unmet medical needs;
- our plans to expand, strengthen, and invest in our global supply chains and manufacturing infrastructure and capabilities, including for cell and gene therapies;
- our ability to attract and retain skilled personnel;
- our expectations involving governmental cost containment and other regulatory efforts;
- our expectations surrounding the competitive landscape facing our products and product candidates;
- our expectations regarding the effect of COVID-19 on, among other things, our financial performance, liquidity, business and operations, including manufacturing, supply chain, research and development activities and pipeline programs; and
- our liquidity and our expectations regarding the possibility of raising additional capital.

Forward-looking statements are subject to certain risks, uncertainties, or other factors that are difficult to predict and could cause actual events or results to differ materially from those indicated in any such statements. These risks, uncertainties, and other factors include, but are not limited to, those described in our Risk Factors, set forth in Part I, Item 1A, and elsewhere in this report and those described from time to time in our future reports filed with the Securities and Exchange Commission.

Any such forward-looking statements are made on the basis of our views and assumptions as of the date of the filing and are not estimates of future performance. Except as required by law, we undertake no obligation to publicly update any forward-looking statements. The reader is cautioned not to place undue reliance on any such statements.

ITEM 1B. UNRESOLVED STAFF COMMENTS

We did not receive any written comments from the Securities and Exchange Commission prior to the date 180 days before the end of the fiscal year ended December 31, 2022 regarding our filings under the Securities Exchange Act of 1934, as amended, that have not been resolved.

ITEM 2. PROPERTIES

Corporate Headquarters

We lease approximately 1.1 million square feet of office and laboratory space at our corporate headquarters in Boston, Massachusetts in two buildings pursuant to two leases that we entered into in May 2011. These leases commenced in December 2013 and extend until December 2028. We have an option to extend the term of the leases for an additional ten years.

Additional United States and Worldwide Locations

In addition to our corporate headquarters, we lease an aggregate of approximately 838,000 square feet of space globally. This space includes logistical, laboratory, commercial and manufacturing operations, as well as laboratory and office space to support our research and development organizations. We also own approximately 213,000 square feet at our continuous manufacturing facility in Massachusetts.

ITEM 3. LEGAL PROCEEDINGS

We are not currently subject to any material legal proceedings.

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

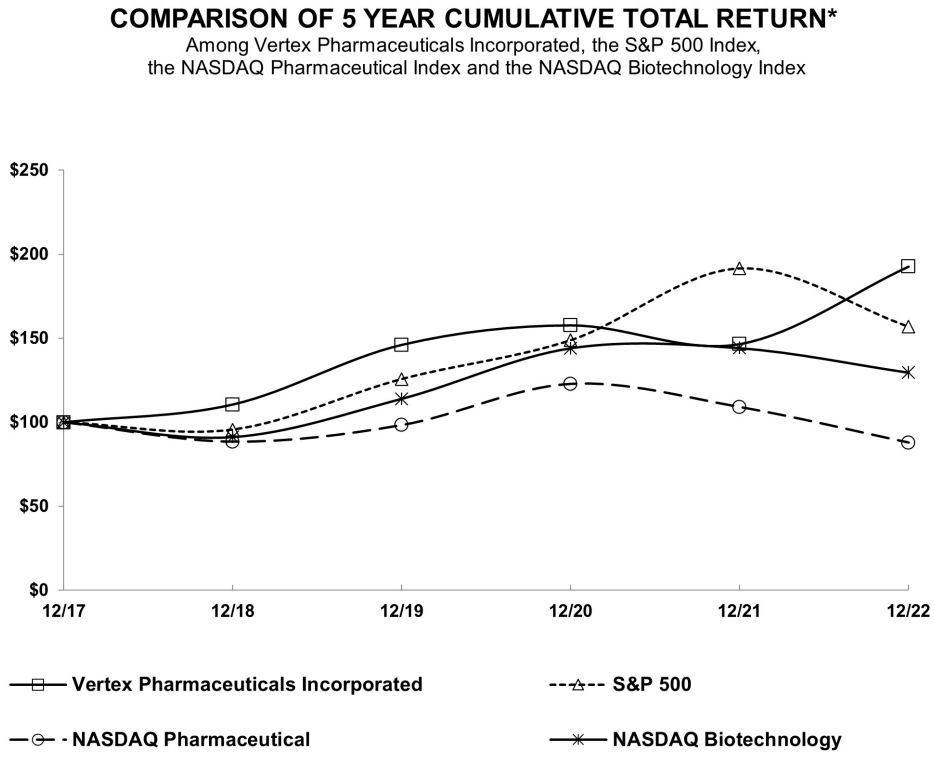
Our common stock is traded on The Nasdaq Global Select Market under the symbol "VRTX."

Shareholders

As of January 31, 2023, there were 107 holders of record of our common stock.

Performance Graph

Our performance graph includes the NASDAQ Biotechnology Index, which we believe is a comparable index consisting of companies with similar industry classifications, and which we plan to use in our future performance graphs.



*$100 invested on 12/31/17 in stock or index, including reinvestment of dividends.
Fiscal year ending December 31.

Dividends

We have never paid any cash dividends on our common stock, and we do not anticipate paying any in the foreseeable future.

Issuer Repurchases of Equity Securities

In June 2021, our Board of Directors approved a share repurchase program (the "2021 Share Repurchase Program"), pursuant to which we were authorized to repurchase up to $1.5 billion of our common stock by December 31, 2022. We did not repurchase any shares of our common stock under the 2021 Share Repurchase Program in the three months ended December 31, 2022. On December 31, 2022, the 2021 Share Repurchase Program expired with $499.7 million remaining authorization.

In February 2023, our Board of Directors approved a share repurchase program (the "2023 Share Repurchase Program") pursuant to which we are authorized to repurchase up to $3.0 billion of our common stock.

ITEM 6. [RESERVED]

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

Our discussion and analysis of our financial condition and results of operations for 2022 as compared to 2021 are discussed below. For a discussion of our financial condition and results of operations for 2021 as compared to 2020, please refer to Item 7, "Management's Discussion and Analysis of Financial Condition and Results of Operations" in our 2021 Annual Report on Form 10-K, except as set forth below.

OVERVIEW

We are a global biotechnology company that invests in scientific innovation to create transformative medicines for people with serious diseases, with a focus on specialty markets. We have four approved medicines that treat the underlying cause of cystic fibrosis ("CF"), a life-threatening genetic disease, and we continue to focus on developing additional treatments for CF. Beyond CF, we have a pipeline that includes mid- and late-stage clinical programs in sickle cell disease, beta thalassemia, acute and neuropathic pain, APOL1-mediated kidney disease, type 1 diabetes, and alpha-1 antitrypsin deficiency, and earlier-stage programs in diseases such as muscular dystrophies.

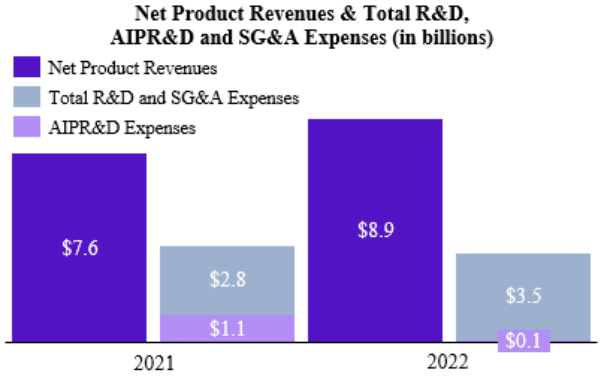
Our triple combination regimen, TRIKAFTA/KAFTRIO (elexacaftor/tezacaftor/ivacaftor and ivacaftor), was approved in 2019 in the United States (the "U.S.") and in 2020 in the European Union (the "E.U."). Collectively, our four medicines are being used by the majority of the approximately 88,000 people with CF in North America, Europe, and Australia. We are evaluating our medicines in additional patient populations, including younger children, with the goal of having small molecule treatments for all people who have at least one mutation in their cystic fibrosis transmembrane conductance regulator ("CFTR") gene that is response to our CFTR modulators. We also are pursuing genetic therapies for people with CF who do not make CFTR protein and, as a result, cannot benefit from our current CF medicines.

Financial Highlights

Revenues — In 2022, our net product revenues increased to $8.9 billion as compared to $7.6 billion in 2021, primarily due to the strong uptake of TRIKAFTA/KAFTRIO in multiple countries internationally and continued steady performance of TRIKAFTA in the U.S., following the June 2021 launch of TRIKAFTA for children with CF 6 through 11 years of age.

Expenses — Our total research and development ("R&D"), acquired in-process research and development ("AIPR&D"), and selling, general and administrative ("SG&A") expenses decreased to $3.6 billion as compared to $3.9 billion in 2021. The decrease was primarily due to decreased AIPR&D following a $900.0 million upfront payment we made in 2021 to CRISPR in connection with an amendment to our exa-cel collaboration, partially offset by increased spend to advance the progression of several product candidates into mid- to late-stage clinical development. Cost of sales was 12% of our net product revenues in 2022 and 2021.

Cash — Our cash, cash equivalents and marketable securities increased to $10.8 billion as of December 31, 2022 as compared to $7.5 billion as of December 31, 2021 primarily due to our net product revenues and operating cash flows, partially offset by income tax payments and our $315.0 million acquisition of ViaCyte.



Business Updates

Marketed Products

We expect to continue to grow our CF business by increasing the number of people with CF who are eligible and able to receive our medicines, including younger people, and providing improved treatment options for people who are already eligible for one of our medicines. Recent and anticipated progress in activities supporting these efforts is included below:

- The European Commission and the United Kingdom's Medicines and Healthcare products Regulatory Agency ("MHRA") granted marketing authorization for KAFTRIO for the treatment of children with CF 6 through 11 years of age who have at least one F508del mutation in the CFTR gene.
- The U.S. Food and Drug Administration (the "FDA") approved the use of ORKAMBI in children with CF 12 months to less than 24 months of age who are homozygous for the F508del mutation in the CFTR gene.
- In the fourth quarter of 2022, we submitted global regulatory filings for TRIKAFTA/KAFTRIO in children with CF 2 to 5 years of age and for KALYDECO in children with CF from 1 month to less than 4 months of age.
- TRIKAFTA/KAFTRIO is now approved and reimbursed or accessible in more than 30 countries outside the U.S.

Pipeline

We continue to advance a pipeline of potentially transformative small molecule and cell and genetic therapies aimed at treating serious diseases. Recent and anticipated progress in activities supporting these efforts is included below.

Cystic Fibrosis

- We are conducting two Phase 3 global, randomized, double-blind, active-controlled clinical trials, SKYLINE 102 and SKYLINE 103, evaluating our new once-daily investigational triple combination of vanzacaftor/tezacaftor/deutivacaftor, formerly known as VX-121/tezacaftor/VX-561, in people with CF 12 years of age and older, and have completed enrollment in these trials. We expect to complete these clinical trials by the end of 2023. We also have initiated a clinical trial of vanzacaftor/tezacaftor/deutivacaftor in children with CF 6 to 11 years of age, known as the RIDGELINE study.
- In collaboration with Moderna, we are developing VX-522, an mRNA therapeutic for the treatment of people with CF who do not produce any CFTR protein. In December 2022, the FDA cleared our Investigational New Drug Application ("IND") for VX-522. We have initiated a single-ascending dose clinical trial for VX-522 in people with CF, which is active and enrolling patients. We expect to complete this single ascending dose clinical trial and initiate the multiple ascending dose clinical trial in 2023. The FDA has granted Fast Track designation for VX-522.

Sickle Cell Disease and Beta Thalassemia

- We are evaluating the use of a non-viral *ex vivo* CRISPR gene-editing therapy, exagamglogene autotemcel ("exa-cel"), formerly known as CTX001, for the treatment of sickle cell disease ("SCD") and transfusion-dependent beta thalassemia ("TDT").
- In the fourth quarter of 2022, we completed regulatory submissions to the European Medicines Agency ("EMA") and the MHRA for exa-cel for SCD and TDT, and both the EMA and the MHRA have validated the marketing authorization application. Exa-cel has been granted EMA Priority Medicines ("PRIME") designation in the E.U. and Orphan Drug designation in the E.U. and the United Kingdom (the "U.K.").
- In November 2022, we initiated the submission of a biologics licensing application ("BLA") for exa-cel for SCD and TDT for rolling review by the FDA, and expect to complete the submission by the end of the first quarter of 2023. In the U.S., exa-cel has been granted Fast Track, Regenerative Medicine Advanced Therapy, Rare Pediatric Disease, and Orphan Drug designations.
- Two additional Phase 3 clinical trials evaluating exa-cel in pediatric patients with SCD and TDT are ongoing.

Pain

- We have discovered multiple selective small molecule inhibitors of NaV1.8, with the objective of creating a new class of pain medicines that provide effective non-opioid pain relief, without abuse potential. In March 2022, we announced positive Phase 2 data for VX-548, a NaV1.8 inhibitor, for treatment of acute pain. We have initiated two randomized, double-blind, placebo-controlled Phase 3 trials with a total of 2,000 patients with moderate to severe acute pain following bunionectomy or abdominoplasty surgery. The Phase 3 program for VX-548 also includes a single-arm study evaluating the safety and effectiveness of VX-548 in multiple other types of moderate to severe pain. We expect to complete these Phase 3 trials in late 2023 or early 2024.
- The FDA granted VX-548 Breakthrough Therapy and Fast Track designations for the treatment of moderate to severe acute pain.
- At the end of 2022, we initiated a Phase 2 clinical trial evaluating VX-548 in diabetic peripheral neuropathy, a common form of peripheral neuropathic pain.

APOL1-Mediated Kidney Disease

- Inaxaplin, formerly known as VX-147, is our small molecule for the treatment of APOL1-mediated kidney disease ("AMKD"), including APOL1-mediated focal segmental glomerulosclerosis ("FSGS"). Based on positive Phase 2 data in FSGS, we initiated pivotal development of inaxaplin in a single Phase 2/3 adaptive clinical trial in patients with AMKD. We continue to enroll patients in this Phase 2/3 clinical trial and we expect to complete the Phase 2 dose-ranging portion of the trial in 2023.
- The FDA granted inaxaplin Breakthrough Therapy designation for APOL1-mediated FSGS and the EMA granted inaxaplin Orphan Drug and PRIME designations for AMKD.

Type 1 Diabetes

- VX-880 is a stem cell-derived, allogeneic, fully differentiated, insulin-producing islet cell replacement therapy, using standard immunosuppression to protect the implanted cells. A clinical trial is ongoing to evaluate VX-880 as a potential treatment for type 1 diabetes ("T1D"), and proof-of-concept has been achieved. We have completed enrollment in Part B of the Phase 1/2 clinical trial and, after completion of Part B, we expect to begin Part C of the trial, with concurrent dosing, in 2023.
- We continue to advance additional programs in T1D, in which these same stem cell-derived, fully differentiated, insulin-producing islet cells are encapsulated and implanted in an immunoprotective device or are modified to produce hypoimmune cells with the goal of eliminating the need for immunosuppression. In December 2022, our Clinical Trial Application ("CTA") in Canada for VX-264, the cells and device program, was authorized and we plan to begin screening, enrollment and dosing in Canada in the coming months. In the U.S., the IND is on hold.

Alpha-1 Antitrypsin Deficiency

- We are working to address the underlying genetic cause of alpha-1 antitrypsin ("AAT") deficiency ("AATD"). We are developing novel small molecule correctors of Z-AAT protein folding, with the goal of enabling the secretion of functional AAT into the blood and addressing both the lung and the liver aspects of AATD. We have initiated a Phase 1 clinical trial for VX-634, which is the first in a series of next-wave investigational molecules with significantly improved potency and drug-like properties as compared to our previous AAT correctors, allowing potential exploration of the full dose response.
- We initiated a second Phase 2 clinical trial of VX-864, a first-generation AAT corrector, to assess the impact of longer-term treatment on the liver, as well as the levels of functional AAT in the plasma.

Duchenne Muscular Dystrophy

- We are investigating a novel approach to treating Duchenne muscular dystrophy ("DMD"), which delivers CRISPR/Cas9 gene-editing technology to muscle cells, with the goal of restoring near-full length dystrophin protein expression by targeting specific mutations in the dystrophin gene that cause the disease. We are conducting enabling studies for our first in vivo gene-editing therapy for DMD and we expect to submit an IND for this program in 2023.

Investment in External Innovation

Recent investments in external innovation are included below.

- We acquired from Catalyst Biosciences, Inc. (“Catalyst”) a portfolio of protease medicines that target the complement system and related intellectual property.
- We acquired ViaCyte, Inc. (“ViaCyte”), a biotechnology company focused on delivering novel stem cell-derived cell replacement therapies as a potential functional cure for T1D. A Phase 1/2 clinical trial of VCTX-211, a hypoimmune cell program that we are developing in partnership with CRISPR Therapeutics AG (“CRISPR”), is active and enrolling patients.
- We established a strategic collaboration and licensing agreement with Entrada Therapeutics, Inc. (“Entrada”), focused on discovering and developing intracellular Endosomal Escape Vehicle (“EEV”) therapeutics for DM1 (the “Entrada Agreement”).

Our Business Environment

Our net product revenues come from the sale of our medicines for the treatment of CF. Our CF strategy involves continuing to develop and obtain approval and reimbursement for treatment regimens that will provide benefits to all people with CF and increasing the number of people with CF eligible and able to receive our medicines, including through label expansions, expanded reimbursement, and the development of new medicines. We are advancing our pipeline of product candidates for the treatment of serious diseases outside of CF. Our strategy is to combine transformative advances in the understanding of causal human biology and the science of therapeutics to discover and develop innovative medicines. This approach includes advancing multiple compounds from each program, spanning multiple modalities, into early clinical trials to obtain patient data that can inform selection of the most promising compounds for later-stage development, and to inform discovery and development of additional compounds. We aim to rapidly follow our first-in-class therapies that achieve proof-of-concept with potential best-in-class candidates to provide durable clinical and commercial success.

In pursuit of new product candidates and therapies in specialty markets, we invest in research and development. We believe that pursuing research in diverse areas allows us to balance the risks inherent in product development and may provide product candidates that will form our pipeline in future years. To supplement our internal research programs, we acquire technologies and programs and collaborate with biopharmaceutical and technology companies, leading academic research institutions, government laboratories, foundations and other organizations, as needed, to advance research in our areas of therapeutic interest and to access technologies needed to execute on our strategy.

Discovery and development of a new pharmaceutical or biological product is a difficult and lengthy process that requires significant financial resources along with extensive technical and regulatory expertise. Across the industry, most potential drug or biological products never progress into development, and most products that do advance into development never receive marketing approval. Our investments in product candidates are subject to considerable risks. We closely monitor the results of our discovery, research, clinical trials and nonclinical studies and frequently evaluate our product development programs in light of new data and scientific, business and commercial insights, with the objective of balancing risk and potential. This process can result in rapid changes in focus and priorities as new information becomes available and as we gain additional understanding of our ongoing programs and potential new programs, as well as those of our competitors.

Our business also requires ensuring appropriate manufacturing and reimbursement of our products. As we advance our product candidates through clinical development toward commercialization and market and sell our approved products, we build and maintain our supply chain and quality assurance resources. We rely on a global network of third parties and our internal capabilities to manufacture and distribute our products for commercial sale and post-approval clinical trials and to manufacture and distribute our product candidates for clinical trials. In addition to establishing supply chains for each new approved product, we adapt our supply chain for existing products to include additional formulations or to increase scale of production for existing products as needed. The processes for cell and genetic therapies can be more complex than those required for small molecule drugs and require additional investments in different systems, equipment, facilities and expertise. We are focused on ensuring the stability of the supply chains for our current products, as well as for our pipeline programs.

Sales of our products depend, to a large degree, on the extent to which our products are reimbursed by third-party payors, such as government health programs, commercial insurance and managed health care organizations. Reimbursement for our products, including our potential pipeline therapies, cannot be assured and may take significant periods of time to obtain. We

dedicate substantial management and other resources to obtain and maintain appropriate levels of reimbursement for our products from third-party payors, including governmental organizations in the U.S. and ex-U.S. markets.

In the U.S., we have worked successfully with third-party payors to promptly obtain appropriate levels of reimbursement for our CF medicines. We plan to continue to engage in discussions with numerous commercial insurers and managed health care organizations, along with government health programs that are typically managed by authorities in the individual states, to ensure that payors recognize the significant benefits that our medicines provide and provide patients with appropriate levels of access to our medicines now and in the future. We cannot, however, predict how recent changes in the law, including through the Inflation Reduction Act of 2022, will affect our ability to negotiate successfully with third-party payors in the future. In ex-U.S. markets, we seek government reimbursement for our medicines on a country-by-country or region-by-region basis, as required. This is necessary for each new medicine, as well as for label expansions for our current medicines. We expect to continue to focus significant resources to obtain expanded reimbursement for our CF medicines and, ultimately, pipeline therapies, in U.S. and ex-U.S. markets.

Strategic Transactions

Acquisitions

As part of our business strategy, we seek to acquire products, product candidates and other technologies and businesses that are aligned with our corporate and research and development strategies and complement and advance our ongoing research and development efforts.

In 2022, we acquired ViaCyte, a privately held biotechnology company with intellectual property, tools, technologies and assets with potential to accelerate development of our T1D programs, for $315.0 million; and acquired from Catalyst a portfolio of protease medicines that target the complement system and related intellectual property (the “Catalyst complement portfolio”) for $60.0 million. We expect to continue to identify and evaluate potential acquisitions and may include larger transactions or later-stage assets.

Our acquisition of ViaCyte was accounted for as a business combination. As of the acquisition date, the cash payment was allocated primarily to goodwill and the fair value of an in-process research and development asset. Operating expenses incurred by ViaCyte after the acquisition date and specific expenses associated with the acquisition are reflected in our consolidated statement of operations.

Our acquisition of the Catalyst complement portfolio was accounted for as an asset acquisition because substantially all the fair value acquired was concentrated in in-process research and development assets, which did not constitute a business, and for which we determined there was no alternative future use. As a result, we recorded our $60.0 million upfront payment to AIPR&D.

Please refer to our critical accounting policies, “Acquisitions,” for further information regarding the significant judgments and estimates related to our acquisitions.

Collaboration and In-Licensing Arrangements

We enter into arrangements with third parties, including collaboration and licensing arrangements, for the development, manufacture and commercialization of products, product candidates, and other technologies that have the potential to complement our ongoing research and development efforts.

Over the last several years, we entered into collaboration agreements with a number of companies, including Arbor Biotechnologies, Inc., CRISPR, Kymera Therapeutics, Inc., Mammoth Biosciences, Inc., Moderna, Inc., Obsidian Therapeutics, Inc., and Verve Therapeutics, Inc. Generally, when we in-license a technology or product candidate, we make upfront payments to the collaborator, assume the costs of the program and/or agree to make contingent payments, which could consist of milestone, royalty and option payments. Most of these collaboration payments are expensed as AIPR&D; however, depending on many factors, including the structure of the collaboration, the stage of development of the acquired technology, the significance of the in-licensed product candidate to the collaborator’s operations and the other activities in which our collaborators are engaged, the accounting for these transactions can vary significantly. We expect to continue to identify and evaluate collaboration and licensing opportunities that may be similar to or different from the collaborations and licenses that we have engaged in previously.

In addition, in the fourth quarter of 2022, we announced a strategic collaboration and licensing agreement (the "Entrada Agreement") with Entrada focused on discovering and developing intracellular EEV therapeutics for DM1. In February 2023, the Entrada Agreement closed upon, among other things, the satisfaction of customary closing conditions and the expiration of the waiting period under the Hart-Scott-Rodino Antitrust Improvements Act. Upon closing, we made an upfront payment of approximately $224.0 million to Entrada, and purchased approximately $26.0 million of Entrada's common stock in connection with the Entrada Agreement. We will account for the Entrada Agreement in the first quarter of 2023.

Joint Development and Commercialization Agreement with CRISPR

In 2017, we entered into a joint development and commercialization agreement (the "Original JDCA") with CRISPR, pursuant to which we are developing and preparing to commercialize exa-cel for SCD and TDT. The Original JDCA was entered into following our exercise of an option to co-develop and co-commercialize the hemoglobinopathies program that was contained in a collaboration agreement that we entered into with CRISPR in 2015.

In April 2021, we and CRISPR entered into an amendment and restatement of the Original JDCA (the "A&R JDCA"). In June 2021, we made a $900.0 million upfront payment to CRISPR in connection with the closing of the transactions contemplated by the A&R JDCA. We concluded that we did not have any alternative future use for the acquired in-process research and development and recorded this upfront payment to AIPR&D. Under the terms of the A&R JDCA, we are leading worldwide development, manufacturing, and commercialization of exa-cel. As of July 1, 2021, 60% of the net profits and net losses for exa-cel are allocated to us and 40% of the net profits and net losses for exa-cel are allocated to CRISPR, subject to certain adjustments. CRISPR may earn an additional one-time $200.0 million milestone payment upon regulatory approval of exa-cel. We concluded that the Original JDCA and the A&R JDCA are cost-sharing arrangements, which result in the net impact of the arrangements, excluding amounts recorded to AIPR&D, being recorded in "Research and development expenses" in our consolidated statements of operations.

Acquired In-Process Research and Development

In 2022 and 2021, our AIPR&D included $115.5 million and $1.1 billion, respectively, related to upfront, contingent milestone, or other payments pursuant to our business development transactions, including the collaborations, licenses of third-party technologies, and asset acquisitions described above.

Out-License Agreements

We also have out-licensed internally developed programs to collaborators who are leading the development of these programs. Pursuant to these out-licensing arrangements, our collaborators are responsible for the research, development, and commercialization costs associated with these programs, and we are entitled to receive contingent milestone and/or royalty payments. As a result, we do not expect to incur significant expenses in connection with these programs and have the potential for future collaborative and royalty revenues resulting from these programs. None of our out-license agreements had a significant impact on our consolidated statements of operations during 2022 and 2021.

Please refer to Note B, "Acquired In-Process Research and Development and Other Arrangements," for further information regarding our in-license agreements and out-license agreements.

Strategic Investments

In connection with our business development activities, we have periodically made equity investments in our collaborators. As of December 31, 2022, we held strategic equity investments in certain public and private companies, and we expect to make additional strategic equity investments in the future. While we invest the majority of our cash, cash equivalents, and marketable securities in instruments that meet specific credit quality standards and limit our exposure to any one issue or type of instrument, our strategic investments are maintained and managed separately from our other cash, cash equivalents, and marketable securities. As discussed below in "Other Income (Expense), Net" in our *Results of Operations*, any changes in the fair value of equity investments with readily determinable fair values (including publicly traded securities) are recorded to other income (expense), net in our consolidated statements of operations.

RESULTS OF OPERATIONS

	2022	% Change	2021	% Change	2020
	(in millions, except percentages and per share amounts)				
Revenues	$ 8,930.7	18%	$ 7,574.4	22%	$ 6,205.7
Operating costs and expenses	4,623.3	(4)%	4,792.3	43%	3,349.4
Income from operations	4,307.4	55%	2,782.1	(3)%	2,856.3
Other non-operating (expense) income, net	(75.0)	45%	(51.7)	**	260.6
Provision for income taxes	910.4	134%	388.3	(4)%	405.2
Net income	$ 3,322.0	42%	$ 2,342.1	(14)%	$ 2,711.7
Net income per diluted common share	$ 12.82		$ 9.01		$ 10.29
Diluted shares used in per share calculations	259.1		259.9		263.4

** Not meaningful

Revenues

	2022	% Change	2021	% Change	2020
	(in millions, except percentages)				
TRIKAFTA/KAFTRIO	$ 7,686.8	35%	$ 5,697.2	47%	$ 3,863.8
SYMDEKO/SYMKEVI	180.0	(57)%	420.4	(33)%	628.6
ORKAMBI	510.7	(34)%	771.6	(15)%	907.5
KALYDECO	553.2	(19)%	684.2	(15)%	802.9
Product revenues, net	8,930.7	18%	7,573.4	22%	6,202.8
Other revenues	—	**	1.0	**	2.9
Total revenues	$ 8,930.7	18%	$ 7,574.4	22%	$ 6,205.7

** Not meaningful

Product Revenues, Net

In 2022, our net product revenues increased by $1.4 billion, or 18%, as compared to 2021 primarily due to the launches of TRIKAFTA/ KAFTRIO in multiple countries internationally and the continued performance of TRIKAFTA in the U.S., following the June 2021 launch of TRIKAFTA for children with CF 6 through 11 years of age. Decreases in revenues for our products other than TRIKAFTA/KAFTRIO were primarily the result of patients switching from these medicines to TRIKAFTA/KAFTRIO.

Our net product revenues from the U.S. and from ex-U.S. markets were as follows:

	2022	% Change	2021	% Change	2020
	(in millions, except percentages)				
United States	$ 5,699.3	8%	$ 5,287.3	10%	$ 4,826.4
ex-U.S.	3,231.4	41%	2,286.1	66%	1,376.4
Product revenues, net	$ 8,930.7	18%	$ 7,573.4	22%	$ 6,202.8

We expect that our net product revenues will increase in 2023 as a result of the continued performance of TRIKAFTA/KAFTRIO, label expansions into younger age groups for our previously approved products, and expanded access to our medicines.

Operating Costs and Expenses

	2022	% Change	2021	% Change	2020
	(in millions, except percentages)				
Cost of sales	$ 1,080.3	19%	$ 904.2	23%	$ 736.3
Research and development expenses	2,540.3	31%	1,937.8	18%	1,644.9
Acquired in-process research and development expenses	115.5	(90)%	1,113.3	503%	184.6
Selling, general and administrative expenses	944.7	12%	840.1	9%	770.5
Change in fair value of contingent consideration	(57.5)	**	(3.1)	**	13.1
Total costs and expenses	$ 4,623.3	(4)%	$ 4,792.3	43%	$ 3,349.4

** Not meaningful

Beginning in 2022, we separately classify upfront, contingent milestone, or other payments pursuant to our business development transactions, including collaborations, licenses of third-party technologies, and asset acquisitions as “Acquired in-process research and development expenses,” in our consolidated statements of operations in cases where such acquired assets do not have an alternative future use. To conform prior periods to our current presentation, we have reclassified $1.1 billion and $184.6 million from “Research and development expenses” to AIPR&D for 2021 and 2020, respectively.

Cost of Sales

Our cost of sales primarily consists of third-party royalties payable on net sales of our products as well as the cost of producing inventories. Pursuant to our agreement with the Cystic Fibrosis Foundation, our tiered third-party royalties on sales of TRIKAFTA/KAFTRIO, SYMDEKO/SYMKEVI, KALYDECO, and ORKAMBI, calculated as a percentage of net sales, range from the single digits to the sub-teens, with royalties on sales of TRIKAFTA/KAFTRIO lower than for our other products. Over the last several years, our cost of sales has been increasing due to increased net product revenues. Our cost of sales as a percentage of our net product revenues was 12% in each of 2022 and 2021. In 2023, we expect our total cost of sales will increase due to expected increases in our net product revenues and our cost of sales as a percentage of our net product revenues will be similar to our cost of sales as a percentage of net product revenues in 2022 and 2021.

Research and Development Expenses

	2022	% Change	2021	% Change	2020
	(in millions, except percentages)				
Research expenses	$ 626.7	22%	$ 512.3	13%	$ 452.1
Development expenses	1,913.6	34%	1,425.5	20%	1,192.8
Total research and development expenses	$ 2,540.3	31%	$ 1,937.8	18%	$ 1,644.9

Our research and development expenses include internal and external costs incurred for research and development of our products and product candidates. We do not assign our internal costs, such as salary and benefits, stock-based compensation expense, laboratory supplies and other direct expenses and infrastructure costs, to individual products or product candidates, because the employees within our research and development groups typically are deployed across multiple research and development programs. We assign external costs of services provided to us by clinical research organizations and other outsourced research by individual program. Our internal costs are significantly greater than our external costs. All research and development costs for our products and product candidates are expensed as incurred.

Over the past three years, we have incurred $7.5 billion in total research and development and AIPR&D expenses associated with product discovery and development. The successful development of our product candidates is highly uncertain and subject to a number of risks. In addition, the duration of clinical trials may vary substantially according to the type, complexity and novelty of the product candidate and the disease indication being targeted. The FDA and comparable agencies in foreign countries impose substantial requirements on the introduction of therapeutic pharmaceutical products, typically requiring lengthy and detailed laboratory and clinical testing procedures, sampling activities and other costly and time-consuming procedures. Data obtained from nonclinical and clinical activities at any step in the testing process may be adverse and lead to discontinuation or redirection of development activities. Data obtained from these activities also are susceptible to varying interpretations, which could delay, limit or prevent regulatory approval. The duration and cost of discovery, nonclinical studies and clinical trials may vary significantly over the life of a project and are difficult to predict. Therefore, accurate and meaningful estimates of the ultimate costs to bring our product candidates to market are not available.

Any estimates regarding development and regulatory timelines for our product candidates are highly subjective and subject to change. Until we have data from Phase 3 clinical trials, we cannot make a meaningful estimate regarding when, or if, a clinical development program will generate revenues and cash flows.

Research Expenses

	2022	Change %	2021	Change %	2020
	(in millions, except percentages)				
Research Expenses:					
Salary and benefits	$ 159.5	17%	$ 136.7	5%	$ 129.8
Stock-based compensation expense	84.0	9%	77.3	(10)%	85.6
Outsourced services and other direct expenses	189.6	19%	160.0	38%	116.2
Intangible asset impairment charge	13.0	**	—	**	—
Infrastructure costs	180.6	31%	138.3	15%	120.5
Total research expenses	$ 626.7	22%	$ 512.3	13%	$ 452.1

** Not meaningful

Our research expenses have been increasing over the last several years as we have invested in our pipeline and expanded our cell and genetic therapy capabilities, resulting in increased headcount and infrastructure costs associated with our research facilities. We expect to continue to invest in our research programs with a focus on creating transformative medicines for serious diseases.

Development Expenses

	2022	Change %	2021	Change %	2020
	(in millions, except percentages)				
Development Expenses:					
Salary and benefits	$ 475.1	37%	$ 347.6	18%	$ 295.7
Stock-based compensation expense	213.9	12%	191.0	8%	177.1
Outsourced services and other direct expenses	912.9	45%	629.4	23%	512.2
Infrastructure costs	311.7	21%	257.5	24%	207.8
Total development expenses	$ 1,913.6	34%	$ 1,425.5	20%	$ 1,192.8

Our development expenses increased by $488.1 million, or 34%, in 2022 as compared to 2021, primarily due to increased costs to support clinical trials associated with our advancing pipeline programs, including our CF triple combination of vanzacaftor/tezacaftor/deutivacaftor, pain and T1D. We are investing in both our internal headcount, leveraging outsourced services, and investing in infrastructure to support these programs. We expect our development expenses to continue to increase in 2023 as a result of our advancing pipeline programs, including our pain and T1D programs. In 2022 and 2021, costs related to our CF programs represented the largest portion of our development costs.

Acquired In-process Research and Development Expenses

	2022	% Change	2021	% Change	2020
	(in millions, except percentages)				
Acquired in-process research and development expenses	$ 115.5	(90)%	$ 1,113.3	503%	$ 184.6

AIPR&D in 2022 was primarily related to a $60.0 million payment to acquire the Catalyst complement portfolio, a $25.0 million upfront payment pursuant to our license agreement with Verve, and various other payments. AIPR&D in 2021 included the $900.0 million upfront payment to CRISPR, a $60.0 million option payment to ApoLo1 Bio, LLC to buy-out all future milestone and royalty payments, and upfront payments of $31.0 million and $25.0 million to Mammoth Biosciences, Inc. and Arbor Biotechnologies, Inc., respectively. Our AIPR&D has historically fluctuated, and is expected to continue to fluctuate, from one period to another due to upfront, contingent milestone, and other payments pursuant to our existing and future business development transactions, including collaborations, licenses of third-party technologies, and asset acquisitions.

Selling, General and Administrative Expenses

	2022	% Change	2021	% Change	2020
	(in millions, except percentages)				
Selling, general and administrative expenses	$ 944.7	12%	$ 840.1	9%	$ 770.5

Selling, general and administrative expenses increased by 12% in 2022 as compared to 2021, primarily due to the continued investment to support the commercialization of our medicines and increased support for our pipeline product candidates. We expect our selling, general and administrative expenses to continue to increase in 2023 as we progress our efforts in preparation for the commercialization of exa-cel.

Contingent Consideration

The fair value of our contingent consideration decreased by $57.5 million in 2022, primarily as a result of a revision to the scope of certain gene-editing programs in the second quarter of 2022. The fair value of contingent consideration decreased by $3.1 million in 2021. In future periods, we expect the fair value of contingent consideration to increase or decrease based on, among other things, our estimates of the probability of achieving and the timing of these contingent development and regulatory milestone payments, as well as the time value of money and changes in market interest rates.

Other Non-Operating Income (Expense), Net

Interest Income

Interest income increased to $144.6 million in 2022, as compared to $4.9 million in 2021, primarily due to increased market interest rates and increased cash equivalents and available-for-sale debt securities. Our future interest income is dependent on the amount of, and prevailing market interest rates on, our outstanding cash equivalents and available-for-sale debt securities.

Interest Expense

Interest expense was $54.8 million in 2022 as compared to $61.5 million in 2021. The majority of our interest expense in these periods was related to imputed interest expense associated with our leased corporate headquarters in Boston.

Other Income (Expense), Net

Other income (expense), net was expense of $164.8 million in 2022 and income of $4.9 million in 2021. The vast majority of these amounts relate to net unrealized gains or losses resulting from changes in the fair value and sales of certain of our strategic investments. As of December 31, 2022, the fair value of our investments in publicly traded companies was $116.8 million. To the extent that we continue to hold strategic investments in publicly traded companies, we will record other income (expense) related to these investments on a quarterly basis. We expect that due to the volatility of the stock price of biotechnology companies, our other income (expense), net will fluctuate in future periods based on increases or decreases in the fair value of our strategic investments.

Income Taxes

Our effective tax rate fluctuates from year to year due to the global nature of our operations. The factors that most significantly impact our effective tax rate include changes in tax laws, variability in the allocation of our taxable earnings among multiple jurisdictions, the amount and characterization of our research and development expenses, the levels of certain deductions and credits, adjustments to the value of our uncertain tax positions, acquisitions and third-party collaboration and licensing transactions.

Our provision for income taxes was $910.4 million for 2022 and $388.3 million for 2021. Our effective tax rate of 21.5% for 2022 was higher than the U.S. statutory rate primarily due to an increase in our unrecognized tax benefit liabilities associated with intercompany transfer pricing matters partially offset by excess tax benefits related to stock-based compensation, tax credits, and changes in our estimated prior-year tax liabilities.

Our effective tax rate of 14.2% for 2021 was lower than the U.S. statutory rate primarily due to discrete tax benefits of (i) $94.8 million associated with an increase in the U.K.'s corporate tax rate from 19% to 25%, which was enacted in June 2021 and will become effective in April 2023, and (ii) $44.1 million resulting from an R&D tax credit study that we completed in 2021.

LIQUIDITY AND CAPITAL RESOURCES

The following table summarizes the components of our financial condition as of December 31, 2022 and 2021:

	2022	2021	% Change
	(in millions)		
Cash, cash equivalents and marketable securities	$ 10,778.5	$ 7,524.9	43%
Working Capital:			
Total current assets	$ 13,234.8	$ 9,560.6	38%
Total current liabilities	(2,742.1)	(2,142.0)	28%
Total working capital	$ 10,492.7	$ 7,418.6	41%

Working Capital

As of December 31, 2022, total working capital was $10.5 billion, which represented an increase of $3.1 billion from $7.4 billion as of December 31, 2021. The increase in total working capital in 2022 was primarily related to $4.1 billion of cash provided by operations driven by increased product revenues, partially offset by our $295.9 million net payment to acquire ViaCyte and purchases of property and equipment.

Cash Flows

	2022	2021	2020
		(in millions)	
Net cash provided by (used in):			
Operating activities	$ 4,129.9	$ 2,643.5	$ 3,253.5
Investing activities	$ (321.1)	$ (340.9)	$ 99.4
Financing activities	$ (67.7)	$ (1,478.0)	$ (505.3)

Operating Activities

Cash provided by operating activities was $4.1 billion in 2022 as compared to $2.6 billion in 2021 primarily due to a $979.9 million increase in net income resulting from increased product revenues, the $900.0 million upfront payment to CRISPR paid in 2021, and an increase in product revenue accruals, partially offset by higher income tax payments.

Investing Activities

Cash used in investing activities was $321.1 million and $340.9 million in 2022 and 2021, respectively. In 2022, our investing activities included a net payment of $295.9 million to acquire ViaCyte and $204.7 million in purchases of property and equipment, partially offset by net sales and maturities of available-for-sale debt securities of $227.3 million. Our investing activities in 2021 primarily related to purchases of property and equipment, and, to a lesser extent, purchases of notes receivable and strategic investments.

Financing Activities

Cash used in financing activities was $67.7 million and $1.5 billion in 2022 and 2021, respectively. In 2022, the largest portion of our financing activities were payments related to our employee stock benefit plans and payments on finance leases. In 2021, the largest portion of our financing activities was $1.4 billion of share repurchases pursuant to our share repurchase programs.

Sources and Uses of Liquidity

As of December 31, 2022, we had cash, cash equivalents, and marketable securities of $10.8 billion, which represented an increase of $3.3 billion from $7.5 billion as of December 31, 2021. We intend to rely on our existing cash, cash equivalents and marketable securities together with cash flows from product sales as our primary source of liquidity.

We expect that cash flows from our products together with our current cash, cash equivalents and marketable securities will be sufficient to fund our operations for at least the next twelve months. The adequacy of our available funds to meet our future operating and capital requirements will depend on many factors, including the amounts of future revenues generated by our products, and the potential introduction of one or more of our other product candidates to the market, the level of our business development activities and the number, breadth, cost and prospects of our research and development programs.

Credit Facilities & Financing Strategy

We may borrow up to a total of $500.0 million pursuant to a revolving credit facility that we entered into in July 2022 and could repay and reborrow amounts under this revolving credit agreement without penalty. Subject to certain conditions, we could request that the borrowing capacity be increased by an additional $500.0 million, for a total of $1.0 billion. Negative covenants in our credit agreement could prohibit or limit our ability to access this source of liquidity. As of December 31, 2022, the facility was undrawn, and we were in compliance with these covenants.

In July 2022, in conjunction with entering into our new credit agreement, we terminated the $500.0 million credit agreement we entered into in 2019. In September 2022, a $2.0 billion credit agreement we entered into in 2020 expired in accordance with its terms.

We may also raise additional capital by borrowing under credit agreements, through public offerings or private placements of our securities, or securing new collaborative agreements or other methods of financing. We will continue to manage our capital structure and will consider all financing opportunities, whenever they may occur, that could strengthen

our long-term liquidity profile. There can be no assurance that any such financing opportunities will be available on acceptable terms, if at all.

Future Capital Requirements

We have significant future capital requirements, including:

- Expected operating expenses to conduct research and development activities, manufacture and commercialize our existing and future products, and to operate our organization.
- Facility and finance lease obligations as described below.
- Royalties we pay to the Cystic Fibrosis Foundation on sales of our CF products.
- Cash paid for income taxes.

In addition, we have significant potential future capital requirements including:

- We have entered into certain business development-related agreements with third parties that include the funding of certain research, development, and commercialization efforts. Certain of our transactions, including collaborations, licensing arrangements, and asset acquisitions, include the potential for future milestone and royalty payments by us upon the achievement of pre-established developmental and regulatory targets and/or commercial targets. Our obligation to fund these research and development and commercialization efforts and to pay these potential milestone and royalties is contingent upon continued involvement in the programs and/or the lack of any adverse events that could cause the discontinuance of the programs associated with our collaborations, licensing arrangements and acquisitions. We may enter into additional business development transactions, including acquisitions, collaborations, licensing arrangements and equity investments, that require additional capital.
- To the extent we borrow amounts under our existing credit agreement, we would be required to repay any outstanding principal amounts in 2027.
- In February 2023, our Board of Directors approved a share repurchase program, pursuant to which we are authorized to repurchase up to $3.0 billion of our common stock. The share repurchase program does not have an expiration date and can be discontinued at any time.

Additional information on several of our future capital requirements is provided below.

Research and Development Costs

At any point in time, we have several ongoing clinical trials at various stages of clinical development. Our clinical trial costs are dependent on, among other things, our research activities advancing to later-stage clinical development as well as the size, number, and length of our clinical trials.

Leases

Finance Leases

Our corporate headquarters is in two buildings that we lease at Fan Pier in Boston, Massachusetts. We commenced lease payments on these buildings in 2013 and the initial lease periods end in December 2028. We also lease office and laboratory space in San Diego, California. We commenced lease payments for this building in 2019 pursuant to an initial 16-year lease term. We account for each of these buildings as finance leases.

Operating Leases

We account for our remaining real estate leases as operating leases, including office and laboratory space at the Jeffrey Leiden Center for Cell and Genetic Therapies near our corporate headquarters. Base rent payments commenced in 2021 pursuant to an initial 15-year lease term for this building.

Our total future minimum lease payments for our finance and operating leases for each of the next five years and in total are included in Note M, “Leases.” The total future undiscounted minimum lease payments were $666.3 million and $491.3 million related to our finance and operating leases, respectively, as of December 31, 2022.

CRITICAL ACCOUNTING POLICIES AND ESTIMATES

Our discussion and analysis of our financial condition and results of operations are based upon our consolidated financial statements prepared in accordance with generally accepted accounting principles in the U.S. The preparation of these financial statements requires us to make certain estimates and assumptions that affect the reported amounts of assets and liabilities, the disclosure of contingent assets and liabilities at the date of the consolidated financial statements and the reported amounts of revenues and expenses during the reported periods. These items are monitored and analyzed by management for changes in facts and circumstances, and material changes in these estimates could occur in the future. Changes in estimates are reflected in reported results for the period in which the change occurs. We base our estimates on historical experience and various other assumptions that we believe to be reasonable under the circumstances. Actual results may differ from our estimates if past experience or other assumptions do not turn out to be substantially accurate.

We believe that our application of the following accounting policies, each of which requires significant judgments and estimates on the part of management, are the most critical to aid in fully understanding and evaluating our reported financial results:

- revenue recognition;
- acquisitions, including intangible assets, goodwill and contingent consideration; and
- income taxes.

Our accounting policies, including the ones discussed below, are more fully described in Note A, “Nature of Business and Accounting Policies.”

Revenue Recognition

Product Revenues, Net

We generate product revenues from sales in the U.S. and in international markets. We sell our products principally to a limited number of specialty pharmacy and specialty distributors in the U.S., which account for the largest portion of our total revenues. We make international sales primarily through distributor arrangements and to retail pharmacies or pharmacy chains, as well as to hospitals and clinics, many of which are government-owned or supported customers. Our customers in the U.S. subsequently resell our products to patients and health care providers. We contract with government agencies so that our products will be eligible for purchase by, or partial or full reimbursement from, such third-party payors. We recognize net product revenues from sales of our products when our customers obtain control of our products, which typically occurs upon delivery to our customers. Revenues from our product sales are recorded at the net sales price, or transaction price, which requires us to make several significant estimates regarding the net sales price.

The most significant estimate we are required to make is related to government and private payor rebates, chargebacks, discounts and fees, collectively rebates. The values of the rebates provided to third-party payors per course of treatment vary significantly and are based on government-mandated discounts and our arrangements with other third-party payors. To estimate our total rebates, we estimate the percentage of prescriptions that will be covered by each third-party payor, which is referred to as the payor mix. We track available information regarding changes, if any, to the payor mix for our products, to our contractual terms with third-party payors and to applicable governmental programs and regulations and levels of our products in the distribution channel. We adjust our estimated rebates based upon new information as it becomes available, including information regarding actual rebates for our products. Claims by third-party payors for rebates are submitted to us significantly after the related sales, potentially resulting in adjustments in the period in which the new information becomes known. Our credits to revenue related to prior period sales have not been significant (typically less than 1% of gross product revenues) and primarily related to U.S. rebates.

The following table summarizes activity related to our accruals for rebates for 2022, 2021 and 2020:

		(in millions)
Balance as of December 31, 2019	$	635.7
Provision related to 2020 sales		1,284.1
Adjustments related to prior year(s) sales		0.6
Credits/payments made		(1,144.8)
Balance as of December 31, 2020	$	775.6
Provision related to 2021 sales		2,126.1
Adjustments related to prior year(s) sales		(27.6)
Credits/payments made		(2,035.5)
Balance as of December 31, 2021	$	838.6
Provision related to 2022 sales		2,977.2
Adjustments related to prior year(s) sales		(10.4)
Credits/payments made		(2,514.0)
Balance as of December 31, 2022	$	1,291.4

We have also entered into annual contracts with government-owned and supported customers in international markets that limit the amount of annual reimbursement we can receive. Upon exceeding the annual reimbursement amount, products are provided free of charge, which is a material right. We defer a portion of the consideration received, which includes upfront payments and fees, for shipments made up to the annual reimbursement limit as "Other current liabilities." The deferred amount is recognized as revenue when the free products are shipped. To estimate the portion of the consideration received to be recognized as revenue and the portion of the amount to be deferred, we rely on our forecast of the number of units we will distribute during the applicable annual period in each international market in which our contracts with government-owned and supported customers limit the amount of annual reimbursement we can receive. Our forecasts are based on, among other things, our historical experience.

The preceding estimates and judgments materially affect our recognition of net product revenues. Changes in our estimates of net product revenues could have a material effect on net product revenues recorded in the period in which we determine that change occurs.

Acquisitions

As part of our business strategy, we seek to acquire products, product candidates and other technologies and businesses that are aligned with our corporate and research and development strategies and complement and advance our ongoing research and development efforts. If we determine that substantially all the fair value that we acquire in an acquisition is concentrated in a single asset, and the acquisition does not constitute a business, we account for it as an asset acquisition. For an asset acquisition of intellectual property that has not yet achieved regulatory approval, we record our upfront payment to AIPR&D, as long as we determine there is no alternative future use for the asset that was acquired.

If the fair value that we acquired in an acquisition is distributed among more than one asset, and the acquisition constitutes a business, we account for it as a business combination.

We are required to make several significant judgments and estimates to calculate the purchase price for our business combinations and then allocate it to the assets that we have acquired and the liabilities that we have assumed on our consolidated balance sheet. The most significant judgments and estimates relate to the fair value of the in-process research and development assets and contingent consideration liabilities related to these business combinations. Based on these judgments and estimates, the fair value of the goodwill that we record as a result of these business combinations may be material. Once recorded, these assets are subject to quarterly impairment analysis and our contingent consideration liabilities are adjusted quarterly, which requires similar judgments and estimates.

Intangible Assets

In 2022, we recorded a $216.6 million in-process research and development intangible asset related to our acquisition of ViaCyte on our consolidated balance sheet. We also recorded a $13.0 million impairment of an in-process research and development intangible asset to "Research and development expenses," due to a decision to revise the scope of certain acquired gene-editing programs. As of December 31, 2022, we had $603.6 million of in-process research and development assets on our consolidated balance sheet. Each of these assets is accounted for as an indefinite-lived intangible asset and reflected on our consolidated balance sheets until either the project underlying it is completed or the asset becomes impaired. Our in-process research and development intangible assets are tested for impairment on an annual basis, and more frequently if indicators are present or changes in circumstances suggest that impairment may exist. When we determine that an asset has become impaired or we abandon a project, we write down the carrying value of the related intangible asset to its fair value and record an impairment charge in the period in which the impairment occurs.

To determine the fair value of our in-process research and development assets, we have utilized either the multi-period excess earnings or the relief from royalty methods of the income approach. Each method requires us to estimate the probability of technical and regulatory success, revenue projections and growth rates, and appropriate discount and tax rates. The multi-period excess earnings method also requires us to estimate development and commercial costs. The relief from royalty method also requires us to estimate the after-tax royalty savings expected from ownership of the asset that we acquired.

Contingent Consideration

As of December 31, 2022 and 2021, we had $129.0 million and $186.5 million, respectively, of liabilities on our consolidated balance sheets attributable to the fair value of the contingent development and regulatory payments that we may owe to Exonics' former equity holders upon the achievement of certain events. The decrease in fair value of contingent consideration during 2022 was primarily due to a revision to the scope of certain acquired gene-editing programs.

We record an increase or a decrease in the fair value of the contingent consideration liabilities on our consolidated balance sheet and in our consolidated statement of operations on a quarterly basis. We determine the fair value of our contingent consideration liabilities using a probability weighted discounted cash flow method of the income approach, which requires us to make estimates of the timing of regulatory and commercial milestone achievement and the corresponding estimated probability of technical and regulatory success rates. Significant judgment is used in determining the appropriateness of these assumptions during each reporting period. Reasonable changes in these assumptions can cause material changes to the fair value of our contingent consideration liabilities. Due to the early stage of Exonics' programs, these significant assumptions could be affected by future economic and market conditions.

Goodwill

As of December 31, 2022 and 2021, we had goodwill of $1.1 billion and $1.0 billion, respectively, on our consolidated balance sheets. In 2022, we recorded $85.8 million of goodwill on our consolidated balance sheet related to our acquisition of ViaCyte. In 2021, we did not have any business combinations; therefore, we did not record any additional goodwill. Goodwill reflects the difference between the fair value of the consideration transferred and the fair value of the net assets acquired. Thus, the goodwill that we record is dependent on the significant judgments and estimates inherent in the fair value of our in-process research and development assets and contingent consideration liabilities. We have one reporting unit for goodwill reporting purposes. We evaluate our goodwill for impairment on an annual basis, and more frequently if indicators are present or changes in circumstances suggest that impairment may exist. We have not identified any goodwill impairment to date.

Income Taxes

We utilize the asset and liability method of accounting for income taxes. Under this method, deferred tax assets and liabilities are determined based on the difference between the financial statement carrying amounts and tax basis of assets and liabilities using enacted tax rates in effect for years in which the temporary differences are expected to reverse. If our estimate of the tax effect of reversing temporary differences is (i) not reflective of actual outcomes, (ii) modified to reflect new developments or interpretations of the tax law, or (iii) revised to incorporate new accounting principles, or changes in the expected timing or manner of the reversal, our results of operations could be materially impacted.

We provide a valuation allowance when it is more likely than not that deferred tax assets will not be realized. On a

periodic basis, we reassess our valuation allowances on our deferred tax assets, weighing positive and negative evidence to assess the recoverability of the deferred tax assets. Significant judgment is required in making these assessments to maintain or reverse our valuation allowances and, to the extent our future expectations change we would have to assess the recoverability of these deferred tax assets at that time. As of December 31, 2022, we maintained a valuation allowance of $237.8 million related primarily to U.S. state tax attributes.

We record liabilities related to uncertain tax positions by prescribing a minimum recognition threshold and measurement attribute for the financial statement recognition and measurement of a tax position taken or expected to be taken in a tax return. We adjust our liability to reflect any subsequent changes in the relevant facts and circumstances surrounding the uncertain positions. We are subject to tax laws and audits in multiple jurisdictions and significant judgment is required in making this assessment. Consequently, we regularly re-evaluate uncertain tax positions and consider various factors, including, but not limited to, changes in tax law, the measurement of tax positions taken or expected to be taken in tax returns, and changes in facts or circumstances related to a tax position. As of December 31, 2022, our liability for uncertain tax positions was $459.6 million.

RECENT ACCOUNTING PRONOUNCEMENTS

Refer to Note A, “Nature of Business and Accounting Policies,” in the accompanying notes to the consolidated financial statements for a discussion of recent accounting pronouncements and new accounting pronouncements adopted during 2022.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Interest Rate Risk

Financial Instruments

As part of our investment portfolio, we own financial instruments that are sensitive to market risks. The investment portfolio is used to preserve our capital, provide adequate liquidity and earn returns commensurate with our risk appetite. We invest in instruments that meet the credit quality standards outlined in our investment policy, which also limits the amount of credit exposure to any one issue or type of instrument. These instruments principally include securities issued by the U.S. government and its agencies, investment-grade corporate bonds and commercial paper, and money market funds. These investments are denominated in U.S. Dollars and none are held for trading purposes.

All of our interest-bearing securities are subject to interest rate risk and could change in value if interest rates fluctuate. Substantially all of our investment portfolio consists of marketable securities with active secondary or resale markets to help ensure portfolio liquidity, and we have implemented guidelines limiting the term-to-maturity of our investment instruments. Since we account for these securities as available-for-sale, no gains or losses are realized due to changes in the fair value of our investments unless we sell our investments prior to maturity or incur a credit loss. Due to the conservative nature of these instruments, we do not believe that the fair value of our investments has a material exposure to interest rate risk.

While we are exposed to global interest rate fluctuations, our investment portfolio is most affected by fluctuations in U.S. interest rates, which affect the interest earned on our cash, cash equivalents and marketable securities.

Credit Agreement

In 2022, we entered into a $500.0 million unsecured revolving credit facility (“credit agreement”). Loans under this credit agreement bear interest, at our option, at a base rate or a Secured Overnight Financing Rate (“SOFR”), plus an applicable margin based on our consolidated leverage ratio (the ratio of our total consolidated funded indebtedness to our consolidated EBITDA for the most recently completed four fiscal quarter period). Pursuant to our credit agreement, the applicable margin on base rate loans ranges from 0.000% to 0.500% and the applicable margin on SOFR loans ranges from 1.000% to 1.500%. We do not believe that changes in interest rates related to our credit agreement would have a material effect on our consolidated financial statements. As of December 31, 2022, we had no principal or interest outstanding under our credit facility. A portion of our “Interest expense” in 2023 will be dependent on whether, and to what extent, we borrow amounts under this facility.

Foreign Exchange Market Risk

As a result of our foreign operations, we face significant exposure to movements in foreign currency exchange rates, primarily the Euro and British Pound against the U.S. dollar. Fluctuations in the amounts of our foreign revenues and fluctuations in foreign currency exchange rates, may have a positive or negative effect on our foreign exchange rate exposure. The current exposures arise primarily from cash, accounts receivable, intercompany receivables and payables, payables and accruals and inventories.

We have a foreign currency management program, which is separate from our investment policy and portfolio, with the objective of reducing the effect of exchange rate fluctuations on our operating results and forecasted revenues denominated in foreign currencies. We currently have cash flow hedges for the Euro, British Pound, Canadian Dollar, Swiss Franc and Australian Dollar related to a portion of our forecasted product revenues that qualify for hedge accounting treatment under U.S. GAAP. We do not seek hedge accounting treatment for our foreign currency forward contracts related to monetary assets and liabilities that impact our operating results. As of December 31, 2022, we held foreign exchange forward contracts that were designated as cash flow hedges with notional amounts totaling $2.2 billion representing a net fair value of $33.1 million on our consolidated balance sheet.

Although not predictive in nature, we believe a hypothetical 10% threshold reflects a reasonably possible near-term change in exchange rates. If the December 31, 2022 exchange rates were to change by a hypothetical 10%, the fair value recorded on our consolidated balance sheet related to our foreign exchange forward contracts that were designated as cash flow hedges as of December 31, 2022 would change by approximately $220.2 million. However, since these contracts hedge a specific portion of our forecasted product revenues denominated in certain foreign currencies, any change in the fair value of these contracts is recorded in “Accumulated other comprehensive income” on our consolidated balance sheets and is

reclassified to earnings in the same periods during which the underlying product revenues affect earnings. Therefore, any change in the fair value of these contracts that would result from a hypothetical 10% change in exchange rates would be entirely offset by the change in value associated with the underlying hedged product revenues resulting in no impact on our future anticipated earnings and cash flows with respect to the hedged portion of our forecasted product revenues.

Equity Price Risk

Information required by this section is incorporated by reference from the discussion in the "Strategic Investments" section of this Part II, Item 7, "Management's Discussion and Analysis of Financial Condition and Results of Operations."

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

The information required by this Item 8 is contained on pages F-1 through F-45 of this Annual Report on Form 10-K.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE

Not applicable.

ITEM 9A. CONTROLS AND PROCEDURES

(1) Evaluation of Disclosure Controls and Procedures. Our chief executive officer and chief financial officer, after evaluating the effectiveness of our disclosure controls and procedures (as defined in Rule 13a-15(e) and Rule 15d-15(e) promulgated under the Securities Exchange Act of 1934, as amended) as of the end of the period covered by this Annual Report on Form 10-K, have concluded that, based on such evaluation, our disclosure controls and procedures were effective. In designing and evaluating the disclosure controls and procedures, management recognized that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving the desired control objectives, and management necessarily was required to apply our judgment in evaluating the cost-benefit relationship of possible controls and procedures.

(2) Management's Annual Report on Internal Control Over Financial Reporting. Management is responsible for establishing and maintaining adequate internal control over financial reporting. Internal control over financial reporting is defined in Rule 13a-15(f) and Rule 15d-15(f) promulgated under the Securities Exchange Act of 1934, as amended, as a process designed by, or under the supervision of, our principal executive and principal financial officers and effected by our board of directors, management and other personnel, 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. Our internal control over financial reporting include those policies and procedures that:

- pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of our assets;
- provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that our receipts and expenditures are being made only in accordance with authorizations of management and our directors; and
- provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use or disposition of our assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Management assessed the effectiveness of our internal control over financial reporting as of December 31, 2022. In making this assessment, we used the criteria set forth in the *Internal Control—Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission ("COSO"). Based on our assessment, management has concluded that, as of December 31, 2022, our internal control over financial reporting is effective based on those criteria.

Our independent registered public accounting firm, Ernst & Young LLP, issued an attestation report on our internal control over financial reporting. See Section 4 below.

(3) Changes in Internal Controls. During the quarter ended December 31, 2022, there were no changes in our internal control over financial reporting that materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

(4) Report of Independent Registered Public Accounting Firm

To the Shareholders and the Board of Directors of Vertex Pharmaceuticals Incorporated

Opinion on Internal Control Over Financial Reporting

We have audited Vertex Pharmaceuticals Incorporated's internal control over financial reporting as of December 31, 2022, based on criteria established in Internal Control-Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) (the COSO criteria). In our opinion, Vertex Pharmaceuticals Incorporated (the Company) maintained, in all material respects, effective internal control over financial reporting as of December 31, 2022, based on the COSO criteria.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the 2022 consolidated financial statements of the Company and our report dated February 10, 2023, expressed an unqualified opinion thereon.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting included in the accompanying Management's Report on Internal Control Over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects.

Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control Over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ Ernst & Young LLP

Boston, Massachusetts
February 10, 2023

ITEM 9B. OTHER INFORMATION

Amended and Restated By-Laws

On February 8, 2023, our Board of Directors approved an amendment and restatement of our By-Laws (the "Amended and Restated By-Laws"), effective immediately upon approval by the Board. The Amended and Restated By-Laws had the effect of amending the previous By-Laws of the Company by:

- expanding the advanced notice by-law to cover both board nominations by a shareholder and any other business brought by a shareholder before an annual or special meeting (unless the proposal is made pursuant to Rule 14a-8 of the Exchange Act, in which case Rule 14a-8 of the Exchange Act will govern);
- providing that, for an annual meeting of shareholder, a shareholders' advanced notice of shareholder business or a nomination must be provided no earlier than 120 days and no later than 90 days prior to the anniversary date of the immediately preceding annual meeting;
- expanding the disclosures required to be made by a shareholder seeking to bring business or a nomination before a shareholders' meeting under the by-laws, including, among other things, certain ownership information of the nominating shareholder and a completed director questionnaire with respect to the nominee;
- requiring a nominating shareholder to comply with Rule 14a-9 under the U.S. Securities Exchange Act of 1934, as amended, which is also known as the "universal proxy card rules";
- mandating that a nominating shareholder use a color for its proxy card that is other than white;
- expressly permitting the Chief Executive Officer to call special meetings of the Board, and increasing the number of directors necessary to call a special meeting from two to three; and
- expressly stating that the Chief Executive Officer of the Company (which may or may not be the same person as the President of the Company) is an officer of the Company.

The amendments also include various conforming, technical and non-substantive changes, including gender-neutral language.

The foregoing summary of the amendments to the Amended and Restated By-Laws does not purport to be complete and is qualified in its entirety by reference to the Amended and Restated By-Laws, which is filed as Exhibit 3.2 to this Annual Report on Form 10-K and is incorporated herein by reference.

Jeffrey Leiden Amendment

On February 8, 2023, the Company entered into an amendment to Dr. Jeffrey Leiden's employment agreement, which was scheduled to expire on March 31, 2024. Among other things, the amendment extends the term for one year through March 31, 2025 and provides that Dr. Leiden's equity compensation during the final year of the amended employment agreement will be equivalent to his equity compensation in the preceding year.

The foregoing description of the amendment to Dr. Leiden's employment agreement does not purport to be complete and is qualified in its entirety by reference to the full text of such agreement, which is filed as Exhibit 10.23 to this Annual Report on Form 10-K and incorporated herein by reference.

ITEM 9C. DISCLOSURE REGARDING FOREIGN JURISDICTIONS THAT PREVENT INSPECTIONS.

None.

PART III

Portions of our definitive Proxy Statement for the 2023 Annual Meeting of Shareholders ("2023 Proxy Statement") are incorporated by reference into this Part III of our Annual Report on Form 10-K.

ITEM 10. DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE

The information regarding directors required by this Item 10 will be included in our 2023 Proxy Statement and is incorporated herein by reference. We expect this information to be provided under "Election of Directors," "Corporate Governance and Risk Management," "Shareholder Proposals for the 2024 Annual Meeting and Nominations for Director," "Delinquent Section 16(a) Reports" and "Code of Conduct." The information regarding executive officers required by this Item 10 is included in Part I of this Annual Report on Form 10-K.

ITEM 11. EXECUTIVE COMPENSATION

The information required by this Item 11 will be included in the 2023 Proxy Statement and is incorporated herein by reference. We expect this information to be provided under "Compensation Committee Interlocks and Insider Participation," "Compensation Discussion and Analysis," "Compensation and Equity Tables," "Director Compensation," "Management Development and Compensation Committee Report" and/or "Corporate Governance and Risk Management."

ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS

The information required by this Item 12 will be included in the 2023 Proxy Statement and is incorporated herein by reference. We expect this information to be provided under "Security Ownership of Certain Beneficial Owners and Management" and "Equity Compensation Plan Information."

ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE

The information required by this Item 13 will be included in the 2023 Proxy Statement and is incorporated herein by reference. We expect this information to be provided under "Election of Directors," "Corporate Governance and Risk Management," and "Audit and Finance Committee."

ITEM 14. PRINCIPAL ACCOUNTANT FEES AND SERVICES

The information required by this Item 14 will be included in the 2023 Proxy Statement and is incorporated herein by reference. We expect this information to be provided under "Ratification of the Appointment of Independent Registered Public Accounting Firm."

PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES

(a)(1) The Financial Statements required to be filed by Items 8 and 15(c) of Form 10-K, and filed herewith, are as follows:

	Page Number in this Form 10-K
Report of Independent Registered Public Accounting Firm (PCAOB ID: 42)	F-1
Consolidated Statements of Operations for the years ended December 31, 2022, 2021 and 2020	F-3
Consolidated Statements of Comprehensive Income for the years ended December 31, 2022, 2021 and 2020	F-4
Consolidated Balance Sheets as of December 31, 2022 and 2021	F-5
Consolidated Statements of Shareholders' Equity for the years ended December 31, 2022, 2021 and 2020	F-6
Consolidated Statements of Cash Flows for the years ended December 31, 2022, 2021 and 2020	F-7
Notes to Consolidated Financial Statements	F-8

(a)(2) Financial Statement Schedules have been omitted because they are either not applicable or the required information is included in the consolidated financial statements or notes thereto listed in (a)(1) above.

(a)(3) Exhibits.

The following is a list of exhibits filed as part of this Annual Report on Form 10-K.

Exhibit Number	Exhibit Description	Filed with this report	Incorporated by Reference herein from —Form or Schedule	Filing Date/ Period Covered	SEC File/Reg. Number
Plan of Acquisition					
2.1	Agreement and Plan of Merger, dated as of June 6, 2019, among Vertex Pharmaceuticals Incorporated, VXP Merger Sub, Inc., Exonics Therapeutics, Inc. and Shareholder Representative Services LLC, solely in its Capacity as Shareholders' Representative, as amended by the Amendment to Agreement and Plan of Merger, dated as of June 12, 2019, among Vertex Pharmaceuticals Incorporated, VXP Merger Sub, Inc., Exonics Therapeutics, Inc. and Shareholder Representative Services LLC, solely in its Capacity as Shareholders' Representative.†		10-Q (Exhibit 10.1)	August 1, 2019	000-19319
Governance Documents					
3.1	Restated Articles of Organization of Vertex Pharmaceuticals Incorporated, as amended.		10-Q (Exhibit 3.1)	July 26, 2018	000-19319
3.2	Amended and Restated By-Laws of Vertex Pharmaceuticals Incorporated.	X			
Stock Certificate					
4.1	Specimen Stock Certificate.		10-K (Exhibit 4.1)	February 15, 2018	000-19319
4.2	Description of Securities.	X			
Collaboration Agreement					
10.1	Research, Development and Commercialization Agreement, dated as of May 24, 2004, between Vertex Pharmaceuticals Incorporated and Cystic Fibrosis Foundation Therapeutics Incorporated.†		10-Q (Exhibit 10.1)	November 3, 2021	000-19319
10.2	Amendment No. 1 to Research, Development and Commercialization Agreement, dated as of January 6, 2006, between Vertex Pharmaceuticals Incorporated and Cystic Fibrosis Foundation Therapeutics Incorporated.†		10-Q (Exhibit 10.2)	November 3, 2021	000-19319
10.3	Amendment No. 2 to Research, Development and Commercialization Agreement, dated as of March 17, 2006, between Vertex Pharmaceuticals Incorporated and Cystic Fibrosis Foundation Therapeutics Incorporated.		10-Q/A (Exhibit 10.6)	August 19, 2011	000-19319
10.4	Amendment No. 5 to Research, Development and Commercialization Agreement, effective as of April 1, 2011, between Vertex Pharmaceuticals Incorporated and Cystic Fibrosis Foundation Therapeutics Incorporated.†		10-Q (Exhibit 10.3)	November 3, 2021	000-19319

Exhibit Number	Exhibit Description	Filed with this report	Incorporated by Reference herein from —Form or Schedule	Filing Date/ Period Covered	SEC File/Reg. Number
10.5	Amendment No. 7 to Research, Development and Commercialization Agreement, dated October 13, 2016, between Vertex Pharmaceuticals Incorporated and Cystic Fibrosis Foundation Therapeutics Incorporated.†		10-Q (Exhibit 10.4)	November 3, 2021	000-19319
10.6	Amended and Restated Joint Development and Commercialization Agreement, dated April 16, 2021, between Vertex Pharmaceuticals Incorporated, Vertex Pharmaceuticals (Europe) Limited and CRISPR Therapeutics AG, CRISPR Therapeutics Limited, CRISPR Therapeutics, Inc., TRACR Hematology Ltd.†		10-Q (Exhibit 10.1)	July 30, 2021	000-19319
Leases					
10.7	Lease, dated May 5, 2011, between Fifty Northern Avenue LLC and Vertex Pharmaceuticals Incorporated.†		10-Q (Exhibit 10.2)	July 30, 2021	000-19319
10.8	Lease, dated May 5, 2011, between Eleven Fan Pier Boulevard LLC and Vertex Pharmaceuticals Incorporated.†		10-Q (Exhibit 10.3)	July 30, 2021	000-19319
Financing Agreements					
10.9	Credit Agreement, dated as of July 1, 2022, by and among Vertex Pharmaceuticals Incorporated, Bank of America, N.A. and the other lenders party thereto.		10-Q (Exhibit 10.1)	August 5, 2022	000-19319
Equity Plans					
10.1	Amended and Restated 2006 Stock and Option Plan.*		10-Q (Exhibit 10.1)	October 25, 2018	000-19319
10.11	Form of Stock Option Agreement under Amended and Restated 2006 Stock and Option Plan (granted prior to July 30, 2013).*		8-K (Exhibit 10.2)	May 15, 2006	000-19319
10.12	Form of Stock Option Agreement under Amended and Restated 2006 Stock and Option Plan (granted on or after July 30, 2013).*		10-K (Exhibit 10.20)	February 13, 2015	000-19319
10.13	Amended and Restated 2013 Stock and Option Plan.*		DEF 14A (Appendix A)	April 7, 2022	000-19319
10.14	Form of Non-Qualified Stock Option Agreement under 2013 Stock and Option Plan.*		10-K (Exhibit 10.17)	February 13, 2015	000-19319
10.15	Form of Restricted Stock Agreement under 2013 Stock and Option Plan.*		10-K (Exhibit 10.18)	February 13, 2015	000-19319
10.16	Form of Restricted Stock Unit Agreement under 2013 Stock and Option Plan (U.S.).*		10-K (Exhibit 10.25)	February 16, 2016	000-19319
10.17	Form of Restricted Stock Unit Agreement under 2013 Stock and Option Plan (International).*		10-K (Exhibit 10.19)	February 13, 2015	000-19319
10.18	Form of Restricted Stock Unit Agreement Under 2013 Stock and Option Plan.*		10-K (Exhibit 10.17)	February 13, 2020	000-19319
10.19	Non-Employee Director Deferred Compensation Plan.*		10-K (Exhibit 10.27)	February 16, 2016	000-19319
10.20	Vertex Pharmaceuticals Incorporated Employee Stock Purchase Plan.*		DEF 14A (Appendix B)	April 26, 2019	000-19319
Agreements with Executive Officers and Directors					
10.21	Employment Agreement, dated as of April 1, 2020, by and between Vertex Pharmaceuticals Incorporated and Jeffrey M. Leiden, M.D., Ph.D.*		8-K (Exhibit 10.1)	April 1, 2020	000-19319
10.22	Amendment No. 1 to Employment Agreement, between Jeffrey M. Leiden and Vertex Pharmaceuticals Incorporated, dated as of February 7, 2022.*		10-K (Exhibit 10.24)	February 9, 2022	000-19319
10.23	Amendment No. 2 to Employment Agreement, between Jeffrey M. Leiden and Vertex Pharmaceuticals Incorporated, dated as of February 8, 2023*	X			
10.24	Employee Non-disclosure, Non-competition and Inventions Agreement between Jeffrey M. Leiden and Vertex Pharmaceuticals Incorporated, dated December 14, 2011.*		10-K (Exhibit 10.35)	February 22, 2012	000-19319
10.25	Employment Agreement, dated as of July 24, 2019, between Vertex Pharmaceuticals Incorporated and Reshma Kewalramani.*		8-K (Exhibit 10.1)	July 25, 2019	000-19319
10.26	Change of Control Agreement, dated as of July 24, 2019, between Vertex Pharmaceuticals Incorporated and Reshma Kewalramani.*		8-K (Exhibit 10.2)	July 25, 2019	000-19319
10.27	Employment Agreement, dated as of August 27, 2012, between Vertex Pharmaceuticals Incorporated and Stuart Arbuckle.*		10-Q (Exhibit 10.1)	November 6, 2012	000-19319
10.28	Change of Control Agreement, dated as of August 27, 2012, between Vertex Pharmaceuticals Incorporated and Stuart Arbuckle.*		10-Q (Exhibit 10.2)	November 6, 2012	000-19319
10.29	Employment Agreement, dated as of December 12, 2014, between Vertex Pharmaceuticals Incorporated and David Altshuler.*		10-K (Exhibit 10.34)	February 16, 2016	000-19319

Exhibit Number	Exhibit Description	Filed with this report	Incorporated by Reference herein from —Form or Schedule	Filing Date/ Period Covered	SEC File/Reg. Number
10.30	Change of Control Agreement, dated as of December 10, 2014, between Vertex Pharmaceuticals Incorporated and David Altshuler.*		10-K (Exhibit 10.35)	February 16, 2016	000-19319
10.31	Third Amended and Restated Employment Agreement, dated as of February 26, 2013, between Vertex Pharmaceuticals Incorporated and Amit Sachdev.*		10-K (Exhibit 10.42)	February 23, 2017	000-19319
10.32	Third Amended and Restated Change of Control Agreement, dated as of February 26, 2013, between Vertex Pharmaceuticals Incorporated and Amit Sachdev.*		10-K (Exhibit 10.43)	February 23, 2017	000-19319
10.33	Employment Agreement, dated March 28, 2019, by and between Vertex Pharmaceuticals Incorporated and Charles F. Wagner, Jr.*		10-Q (Exhibit 10.1)	May 1, 2019	000-19319
10.34	Change of Control Agreement, dated as of March 28, 2019, by and between Vertex Pharmaceuticals Incorporated and Charles F. Wagner, Jr.*		10-Q (Exhibit 10.2)	May 1, 2019	000-19319
10.35	Employment Agreement, dated August 1, 2020, by and between Vertex Pharmaceuticals Incorporated and Nia Tatsis.*		10-K (Exhibit 10.36)	February 9, 2022	000-19319
10.36	Change of Control Agreement, dated August 1, 2020, by and between Vertex Pharmaceuticals Incorporated and Nia Tatsis.*		10-K (Exhibit 10.37)	February 9, 2022	000-19319
10.37	Vertex Pharmaceuticals Employee Compensation Plan.*	X			
10.38	Vertex Pharmaceuticals Non-Employee Board Compensation.*		10-K (Exhibit 10.39)	February 9, 2022	000-19319
Subsidiaries					
21.1	Subsidiaries of Vertex Pharmaceuticals Incorporated.	X			
Consent					
23.1	Consent of Independent Registered Public Accounting Firm, Ernst & Young LLP.	X			
Certifications					
31.1	Certification of the Chief Executive Officer under Section 302 of the Sarbanes-Oxley Act of 2002.	X			
31.2	Certification of the Chief Financial Officer under Section 302 of the Sarbanes-Oxley Act of 2002.	X			
32.1	Certification of the Chief Executive Officer and the Chief Financial Officer under Section 906 of the Sarbanes-Oxley Act of 2002.	X			
101.INS	XBRL Instance	X			
101.SCH	XBRL Taxonomy Extension Schema	X			
101.CAL	XBRL Taxonomy Extension Calculation	X			
101.LAB	XBRL Taxonomy Extension Labels	X			
101.PRE	XBRL Taxonomy Extension Presentation	X			
101.DEF	XBRL Taxonomy Extension Definition	X			
104	Cover Page Interactive Data File—the cover page interactive data file does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document.	X			

* Management contract, compensatory plan or agreement.

† Confidential portions of this document have been redacted according to the applicable rules.

ITEM 16. FORM 10-K SUMMARY

Not applicable.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of 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.

Vertex Pharmaceuticals Incorporated

February 10, 2023 By: /s/ Reshma Kewalramani

Reshma Kewalramani
Chief Executive Officer

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the dates indicated.

Name	Title	Date
/s/ Reshma Kewalramani Reshma Kewalramani	President, Chief Executive Officer and Director (Principal Executive Officer)	February 10, 2023
/s/ Charles F. Wagner, Jr. Charles F. Wagner, Jr.	Executive Vice President and Chief Financial Officer (Principal Financial Officer)	February 10, 2023
/s/ Kristen C. Ambrose Kristen C. Ambrose	Senior Vice President and Chief Accounting Officer (Principal Accounting Officer)	February 10, 2023
/s/Jeffrey M. Leiden Jeffrey M. Leiden	Executive Chairman	February 10, 2023
/s/ Sangeeta N. Bhatia Sangeeta N. Bhatia	Director	February 10, 2023
/s/ Lloyd Carney Lloyd Carney	Director	February 10, 2023
/s/ Alan Garber Alan Garber	Director	February 10, 2023
/s/ Terrence C. Kearney Terrence C. Kearney	Director	February 10, 2023
/s/ Yuchun Lee Yuchun Lee	Director	February 10, 2023
/s/ Margaret G. McGlynn Margaret G. McGlynn	Director	February 10, 2023
/s/ Diana McKenzie Diana McKenzie	Director	February 10, 2023
/s/ Bruce I. Sachs Bruce I. Sachs	Director	February 10, 2023
/s/ Suketu Upadhyay Suketu Upadhyay	Director	February 10, 2023

Report of Independent Registered Public Accounting Firm

To the Shareholders and the Board of Directors of Vertex Pharmaceuticals Incorporated

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Vertex Pharmaceuticals Incorporated (the Company) as of December 31, 2022 and 2021, the related consolidated statements of operations, comprehensive income, shareholders' equity, and cash flows for each of the three years in the period ended December 31, 2022, and the related notes (collectively referred to as the "consolidated financial statements"). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company at December 31, 2022 and 2021, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2022, in conformity with U.S. generally accepted accounting principles.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 31, 2022, based on criteria established in Internal Control-Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) and our report dated February 10, 2023, expressed an unqualified opinion thereon.

Basis for Opinion

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

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

Critical Audit Matter

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

Revenue recognition - Payor Mix Impact on Measuring Variable Consideration

Description of the Matter

As discussed in Note A to the Company's consolidated financial statements, the Company records product sales at the net sales price, or "transaction price," which requires the Company to make several significant estimates regarding the net sales price. The most significant estimates relate to government rebates, chargebacks, discounts and fees, and collectively rebates. Due to the delay in receipt of claims by third-party payors, the Company estimates the percentage of prescriptions that will be covered by each third-party payor, which is referred to as the payor mix. Rebate accruals inclusive of estimated amounts due for claims not yet received or processed are recorded within accrued expenses on the Company's consolidated balance sheet.

Auditing the measurement of the Company's net product revenues was complex and judgmental due to the significant estimation required in determining the amount of consideration that will be collected net of estimates for payor rebates. In particular, the net sales price is affected by assumptions in payor behavior such as changes in payor mix, payor collections, current customer contractual requirements, and experience with ultimate collection from third-party payors.

How We Addressed the Matter in Our Audit

We obtained an understanding, evaluated the design and tested the operating effectiveness of controls over the Company's revenue recognition process, including controls over the underlying assumptions and inputs used by management to estimate amounts due to third-party payors and the completeness and accuracy of the data used in the estimates. We also tested the Company's controls to assess the completeness and accuracy of the current and historical data that supports the estimate.

Our audit procedures to test the Company's recognition of net product revenues included, among others, assessing the methodology used to determine the estimate and testing the significant assumptions and the underlying data used by the Company in its analysis, which included historical claims data. In addition, we involved our government pricing subject matter professionals to assist in evaluating management's methodology and calculations used in the measurement of certain estimated rebates. To assess the payor mix assumptions we tested contracted rates, historical claims and payment data and related trends, and other relevant factors. We also assessed the historical accuracy of the Company's estimates of third-party payor rebates.

/s/ Ernst & Young LLP

We have served as the Company's auditor since 2005.

Boston, Massachusetts
February 10, 2023

VERTEX PHARMACEUTICALS INCORPORATED

Consolidated Statements of Operations

(in millions, except per share amounts)

	Year Ended December 31,		
	2022	**2021**	**2020**
Revenues:			
Product revenues, net	$ 8,930.7	$ 7,573.4	$ 6,202.8
Other revenues	—	1.0	2.9
Total revenues	8,930.7	7,574.4	6,205.7
Costs and expenses:			
Cost of sales	1,080.3	904.2	736.3
Research and development expenses	2,540.3	1,937.8	1,644.9
Acquired in-process research and development expenses	115.5	1,113.3	184.6
Selling, general and administrative expenses	944.7	840.1	770.5
Change in fair value of contingent consideration	(57.5)	(3.1)	13.1
Total costs and expenses	4,623.3	4,792.3	3,349.4
Income from operations	4,307.4	2,782.1	2,856.3
Interest income	144.6	4.9	22.2
Interest expense	(54.8)	(61.5)	(58.2)
Other (expense) income, net	(164.8)	4.9	296.6
Income before provision for income taxes	4,232.4	2,730.4	3,116.9
Provision for income taxes	910.4	388.3	405.2
Net income	$ 3,322.0	$ 2,342.1	$ 2,711.7
Net income per common share:			
Basic	$ 12.97	$ 9.09	$ 10.44
Diluted	$ 12.82	$ 9.01	$ 10.29
Shares used in per share calculations:			
Basic	256.1	257.7	259.8
Diluted	259.1	259.9	263.4

Please refer to Note A, “Nature of Business and Accounting Policies,” for an explanation of amounts reclassified from “Research and development expenses” to “Acquired in-process research and development expenses” for 2021 and 2020.

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

VERTEX PHARMACEUTICALS INCORPORATED

Consolidated Statements of Comprehensive Income

(in millions)

	Year ended December 31,		
	2022	**2021**	**2020**
Net income	$ 3,322.0	$ 2,342.1	$ 2,711.7
Other comprehensive (loss) income:			
Unrealized holding gains (losses) on marketable securities, net	0.4	(0.8)	(0.2)
Unrealized (losses) gains on foreign currency forward contracts, net of tax of $1.0, $(21.8) and $14.3, respectively	(4.1)	83.2	(51.6)
Foreign currency translation adjustment	(11.4)	2.0	(14.7)
Total other comprehensive (loss) income	(15.1)	84.4	(66.5)
Comprehensive income	$ 3,306.9	$ 2,426.5	$ 2,645.2

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

VERTEX PHARMACEUTICALS INCORPORATED

Consolidated Balance Sheets

(in millions, except share data)

	December 31,	
	2022	**2021**
Assets		
Current assets:		
Cash and cash equivalents	$ 10,504.0	$ 6,795.0
Marketable securities	274.5	729.9
Accounts receivable, net	1,442.2	1,136.8
Inventories	460.6	353.1
Prepaid expenses and other current assets	553.5	545.8
Total current assets	13,234.8	9,560.6
Property and equipment, net	1,108.4	1,094.1
Goodwill	1,088.0	1,002.2
Intangible assets	603.6	400.0
Deferred tax assets	1,246.9	934.5
Operating lease assets	347.4	330.3
Other assets	521.8	110.8
Total assets	$ 18,150.9	$ 13,432.5
Liabilities and Shareholders' Equity		
Current liabilities:		
Accounts payable	$ 303.9	$ 195.0
Accrued expenses	2,126.7	1,678.6
Other current liabilities	311.5	268.4
Total current liabilities	2,742.1	2,142.0
Long-term finance lease liabilities	430.8	509.8
Long-term operating lease liabilities	379.5	377.4
Other long-term liabilities	685.8	303.3
Total liabilities	4,238.2	3,332.5
Commitments and contingencies	—	—
Shareholders' equity:		
Preferred stock, $0.01 par value; 1,000,000 shares authorized; none issued and outstanding	—	—
Common stock, $0.01 par value; 500,000,000 shares authorized, 257,011,628 and 254,479,046 shares issued and outstanding, respectively	2.6	2.5
Additional paid-in capital	7,386.5	6,880.8
Accumulated other comprehensive income	0.8	15.9
Retained earnings	6,522.8	3,200.8
Total shareholders' equity	13,912.7	10,100.0
Total liabilities and shareholders' equity	$ 18,150.9	$ 13,432.5

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

VERTEX PHARMACEUTICALS INCORPORATED

Consolidated Statements of Shareholders' Equity

(in millions)

	Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive Income (Loss)	Retained Earnings (Accumulated Deficit)	Total Shareholders' Equity
	Shares	Amount				
Balance, December 31, 2019	259.0	$ 2.6	$ 7,937.6	$ (2.0)	$ (1,853.0)	$ 6,085.2
Other comprehensive loss, net of tax	—	—	—	(66.5)	—	(66.5)
Net income	—	—	—	—	2,711.7	2,711.7
Repurchases of common stock	(2.4)	(0.0)	(539.1)	—	—	(539.1)
Common stock withheld for employee tax obligations	(0.8)	(0.0)	(200.3)	—	—	(200.3)
Issuance of common stock under benefit plans	4.1	0.0	262.7	—	—	262.7
Stock-based compensation expense	—	—	433.1	—	—	433.1
Balance, December 31, 2020	259.9	$ 2.6	$ 7,894.0	$ (68.5)	$ 858.7	$ 8,686.8
Other comprehensive income, net of tax	—	—	—	84.4	—	84.4
Net income	—	—	—	—	2,342.1	2,342.1
Repurchases of common stock	(7.3)	(0.1)	(1,425.3)	—	—	(1,425.4)
Common stock withheld for employee tax obligations	(0.6)	(0.0)	(135.9)	—	—	(135.9)
Issuance of common stock under benefit plans	2.5	0.0	102.5	—	—	102.5
Stock-based compensation expense	—	—	445.5	—	—	445.5
Balance, December 31, 2021	254.5	$ 2.5	$ 6,880.8	$ 15.9	$ 3,200.8	$ 10,100.0
Other comprehensive loss, net of tax	—	—	—	(15.1)	—	(15.1)
Net income	—	—	—	—	3,322.0	3,322.0
Common stock withheld for employee tax obligations	(0.7)	(0.0)	(172.0)	—	—	(172.0)
Issuance of common stock under benefit plans	3.2	0.1	187.3	—	—	187.4
Stock-based compensation expense	—	—	490.4	—	—	490.4
Balance, December 31, 2022	257.0	$ 2.6	$ 7,386.5	$ 0.8	$ 6,522.8	$ 13,912.7

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

VERTEX PHARMACEUTICALS INCORPORATED

Consolidated Statements of Cash Flows

(in millions)

	Year Ended December 31,		
	2022	**2021**	**2020**
Cash flows from operating activities:			
Net income	$ 3,322.0	$ 2,342.1	$ 2,711.7
Adjustments to reconcile net income to net cash provided by operating activities:			
Stock-based compensation expense	491.3	441.4	429.5
Depreciation expense	148.3	125.6	109.5
Deferred income taxes	(275.9)	(154.6)	277.3
Losses (gains) on equity securities	149.1	(17.1)	(311.9)
(Decrease) increase in fair value of contingent consideration	(57.5)	(3.1)	13.1
Other non-cash items, net	11.8	14.4	78.7
Changes in operating assets and liabilities:			
Accounts receivable, net	(358.6)	(274.7)	(223.4)
Inventories	(136.4)	(92.8)	(132.0)
Prepaid expenses and other assets	(326.4)	(91.8)	(297.6)
Accounts payable	120.8	31.9	51.3
Accrued expenses	542.5	305.4	122.2
Other liabilities	498.9	16.8	425.1
Net cash provided by operating activities	4,129.9	2,643.5	3,253.5
Cash flows from investing activities:			
Payment to acquire ViaCyte, net of cash acquired	(295.9)	—	—
Purchases of available-for-sale debt securities	(692.7)	(528.2)	(431.4)
Sales and maturities of available-for-sale debt securities	920.0	499.3	372.3
Sale of equity securities	—	—	437.6
Purchases of property and equipment	(204.7)	(235.0)	(259.8)
Investment in equity securities and notes receivable	(47.8)	(77.0)	(19.3)
Net cash (used in) provided by investing activities	(321.1)	(340.9)	99.4
Cash flows from financing activities:			
Issuances of common stock under benefit plans	186.3	102.0	264.9
Repurchases of common stock	—	(1,425.4)	(539.1)
Payments in connection with common stock withheld for employee tax obligations	(172.0)	(135.9)	(200.3)
Payments on finance leases	(85.5)	(47.0)	(42.3)
Proceeds from finance leases	—	22.6	13.3
Other financing activities	3.5	5.7	(1.8)
Net cash used in financing activities	(67.7)	(1,478.0)	(505.3)
Effect of changes in exchange rates on cash	(29.2)	(13.4)	20.6
Net increase in cash, cash equivalents and restricted cash	3,711.9	811.2	2,868.2
Cash, cash equivalents and restricted cash—beginning of period	6,800.1	5,988.9	3,120.7
Cash, cash equivalents and restricted cash—end of period	$ 10,512.0	$ 6,800.1	$ 5,988.9
Supplemental disclosure of cash flow information:			
Cash paid for interest	$ 52.3	$ 56.3	$ 54.5
Cash paid for income taxes	$ 1,057.8	$ 476.3	$ 191.8

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

A. Nature of Business and Accounting Policies

Business

Vertex Pharmaceuticals Incorporated ("Vertex," "we," "us" or "our") is a global biotechnology company that invests in scientific innovation to create transformative medicines for people with serious diseases, with a focus on specialty markets. We have four approved medicines that treat the underlying cause of cystic fibrosis ("CF"), a life-threatening genetic disease, and we continue to focus on developing additional treatments for CF. Beyond CF, we have a pipeline that includes mid- and late-stage clinical programs in sickle cell disease, beta thalassemia, acute and neuropathic pain, APOL1-mediated kidney disease, type 1 diabetes, and alpha-1 antitrypsin deficiency, and earlier-stage programs in diseases such as muscular dystrophies.

Our marketed CF medicines are TRIKAFTA/KAFTRIO (elexacaftor/tezacaftor/ivacaftor and ivacaftor), SYMDEKO/SYMKEVI (tezacaftor/ivacaftor and ivacaftor), ORKAMBI (lumacaftor/ivacaftor) and KALYDECO (ivacaftor).

Basis of Presentation

The accompanying consolidated financial statements, which have been prepared in accordance with accounting principles generally accepted in the United States of America ("U.S. GAAP"), reflect the operations of Vertex and our wholly-owned subsidiaries. All material intercompany balances and transactions have been eliminated. We operate in one segment, pharmaceuticals. Please refer to Note R, "Segment Information," for enterprise-wide disclosures regarding our revenues, major customers and long-lived assets by geographic area.

Beginning in 2022, we separately classify upfront, contingent milestone, and other payments pursuant to our business development transactions, including collaborations, licenses of third-party technologies, and asset acquisitions as "Acquired in-process research and development expenses" in our consolidated statements of operations in cases where such acquired assets do not have an alternative future use. To conform prior periods to current presentation, we reclassified $1.1 billion and $184.6 million from "Research and development expenses" to "Acquired in-process research and development expenses" for 2021 and 2020, respectively. Please refer to Note B, "Acquired In-Process Research and Development and Other Arrangements," for further information on these transactions.

Use of Estimates

The preparation of consolidated financial statements in accordance with U.S. GAAP requires us to make certain estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of our consolidated financial statements, and the amounts of revenues and expenses during the reported periods. We base our estimates on historical experience and various other assumptions, including in certain circumstances future projections that we believe to be reasonable under the circumstances. Actual results could differ from those estimates. Changes in estimates are reflected in reported results in the period in which they become known.

Revenue Recognition

We recognize revenue when a customer obtains control of promised goods or services. We record the amount of revenue that reflects the consideration that we expect to receive in exchange for those goods or services. We apply the following five-step model to determine this amount: (i) identification of the promised goods or services in the contract; (ii) determination of whether the promised goods or services are performance obligations, including whether they are distinct in the context of the contract; (iii) measurement of the transaction price, including the constraint on variable consideration; (iv) allocation of the transaction price to the performance obligations; and (v) recognition of revenue when (or as) we satisfy each performance obligation.

We only apply the five-step model to contracts when it is probable that we will collect the consideration to which we are entitled in exchange for the goods or services that we transfer to the customer. Once a contract is determined to be within the scope of Accounting Standards Codification ("ASC") 606, *Revenue from Contracts with Customers* at contract inception, we review the contract to determine which performance obligations we must deliver and which of these performance obligations are distinct. We recognize as revenue the amount of the transaction price that is allocated to each performance obligation

when that performance obligation is satisfied or as it is satisfied. Generally, our performance obligations are transferred to customers at a point in time, typically upon delivery.

Product Revenues, Net

We sell our products principally to a limited number of specialty pharmacy and specialty distributors in the United States (the "U.S."), which account for the largest portion of our total revenues. We make international sales primarily to specialty distributors and retail pharmacy chains, as well as hospitals and clinics, many of which are government-owned or supported. Our customers in the U.S. subsequently resell the products to patients and health care providers. We recognize net product revenues from sales when our customers obtain control of our products, which typically occurs upon delivery to our customers. Our payment terms are approximately 30 days in the U.S. and consistent with prevailing practice in international markets.

Revenues from product sales are recorded at the net sales price, or "transaction price," which includes estimates of variable consideration that result from (a) invoice discounts for prompt payment and distribution fees, (b) government and private payor rebates, chargebacks, discounts and fees and (c) costs of co-pay assistance programs for patients, as well as other incentives for certain indirect customers. Reserves are established for the estimates of variable consideration based on the amounts earned or to be claimed on the related sales. The reserves are classified as reductions to "Accounts receivable, net" if payable to a customer or "Accrued expenses" if payable to a third-party. Where appropriate, we utilize the expected value method to determine the appropriate amount for estimates of variable consideration based on factors such as our historical experience, current contractual and statutory requirements, specific known market events and trends, industry data and forecasted customer buying and payment patterns. The amount of variable consideration that is included in the transaction price may be constrained and is included in net product revenues only to the extent that it is probable that a significant reversal in the amount of the cumulative revenue recognized will not occur in a future period. Actual amounts of consideration ultimately received may differ from our estimates. If actual results vary from our estimates, we adjust these estimates, which would affect net product revenue and earnings in the period such variances become known.

Invoice Discounts and Distribution Fees: We generally provide invoice discounts on product sales to our customers for prompt payment and pay fees for distribution services, such as fees for certain data that customers provide to us. We estimate that, based on our experience, our customers will earn these discounts and fees, and deduct the full amount of these discounts and fees from our gross product revenues and accounts receivable at the time such revenues are recognized.

Rebates, Chargebacks, Discounts and Fees: We contract with government agencies (our "Third-party Payors") so that products will be eligible for purchase by, or partial or full reimbursement from, such Third-party Payors. We estimate the rebates, chargebacks, discounts and fees we will provide to Third-party Payors and deduct these estimated amounts from our gross product revenues at the time the revenues are recognized. For each product, we estimate the aggregate rebates, chargebacks and discounts that we will provide to Third-party Payors based upon (i) our contracts with these Third-party Payors, (ii) the government-mandated discounts and fees applicable to government-funded programs, (iii) information obtained from our customers and other third-party data regarding the payor mix for such product and (iv) historical experience.

Other Incentives: Other incentives that we offer include co-pay mitigation rebates that we provide to commercially insured patients who have coverage and who reside in states that permit co-pay mitigation programs. Based upon the terms of our co-pay mitigation programs, we estimate average co-pay mitigation amounts for each of our products to establish appropriate accruals.

We make significant estimates and judgments that materially affect our recognition of net product revenues. We adjust our estimated rebates, chargebacks and discounts based on new information, including information regarding actual rebates, chargebacks and discounts for our products, as it becomes available. Claims by third-party payors for rebates, chargebacks and discounts frequently are submitted to us significantly after the related sales, potentially resulting in adjustments in the period in which the new information becomes known. Our credits to product revenue related to prior period sales have not been significant and primarily related to rebates and discounts.

We exclude taxes collected from customers relating to product sales and remitted to governmental authorities from revenues.

Contract Liabilities

We had contract liabilities of $159.6 million and $171.7 million as of December 31, 2022 and 2021, respectively, related to annual contracts with government-owned and supported customers in international markets that limit the amount of annual reimbursement we can receive. Upon exceeding the annual reimbursement amount, products are provided free of charge, which is a material right. These contracts include upfront payments and fees. We defer a portion of the consideration received for shipments made up to the annual reimbursement limit as a portion of "Other current liabilities." The deferred amount is recognized as revenue when the free products are shipped. Our product revenue contracts include performance obligations that are one year or less.

Our contract liabilities at the end of each fiscal year relate to contracts with annual reimbursement limits in international markets in which the annual period associated with the contract is not the same as our fiscal year. In these markets we recognize revenues related to performance obligations satisfied in previous years; however, these revenues do not relate to any performance obligations that were satisfied more than 12 months prior to the beginning of the current year. During the years ended December 31, 2022, 2021 and 2020, we recorded $171.7 million, $191.5 million and $62.3 million, respectively, of revenues that were recorded as contract liabilities at the beginning of the year.

Concentration of Credit Risk

Financial instruments that potentially subject us to concentration of credit risk consist principally of cash equivalents and marketable securities. We place these investments with highly rated financial institutions, and, by policy, limit the amount of credit exposure to any one financial institution. We also maintain a foreign currency hedging program that includes foreign currency forward contracts with several counterparties. We have not experienced any credit losses related to these financial instruments and do not believe we are exposed to any significant credit risk related to these instruments.

We are also subject to credit risk from our accounts receivable related to our product sales and collaborators. We evaluate the creditworthiness of each of our customers and have determined that all our material customers are creditworthy. To date, we have not experienced significant losses with respect to the collection of our accounts receivable. We believe that our allowances, which are not significant to our consolidated financial statements, are adequate at December 31, 2022. Please refer to Note R, "Segment Information," for further information.

Cash and Cash Equivalents

We consider all highly liquid investments with original maturities of three months or less at the date of purchase to be cash equivalents.

Marketable Securities

As of December 31, 2022, our marketable securities consisted of investments in available-for-sale debt securities and corporate equity securities with readily determinable fair values. We classify marketable securities with current maturities of less than one year as current assets on our consolidated balance sheets. The remainder of our marketable securities are classified as long-term assets within "Other assets" on our consolidated balance sheets. The fair value of these securities is based on quoted prices for identical or similar assets.

We record unrealized gains (losses) on available-for-sale debt securities as a component of "Accumulated other comprehensive income," which is a separate component of shareholders' equity on our consolidated balance sheets, until such gains and losses are realized. Realized gains and losses, if any, are determined using the specific identification method.

For available-for-sale debt securities in unrealized loss positions, we are required to assess whether to record an allowance for credit losses using an expected loss model. A credit loss is limited to the amount by which the amortized cost of an investment exceeds its fair value. A previously recognized credit loss may be decreased in subsequent periods if our estimate of fair value for the investment increases. To determine whether to record a credit loss, we consider issuer specific credit ratings and historical losses as well as current economic conditions and our expectations for future economic conditions.

We record changes in the fair value of our investments in corporate equity securities to "Other (expense) income, net" in our consolidated statements of operations. Realized gains and losses, which are also included in "Other (expense) income, net," are determined on an original weighted-average cost basis.

Accounts Receivable

We deduct invoice discounts for prompt payment and fees for distribution services from our accounts receivable based on our experience that our customers will earn these discounts and fees. Our estimates for our allowance for credit losses, which has not been significant to date, is determined based on existing contractual payment terms, historical payment patterns, current economic conditions and our expectation for future economic conditions.

Stock-based Compensation Expense

We expense the fair value of employee restricted stock units and other forms of stock-based employee compensation over the associated employee service period on a straight-line basis. Stock-based compensation expense is determined based on the fair value of the award at the grant date and is adjusted each period to reflect actual forfeitures and the outcomes of certain performance conditions.

For awards with performance conditions in which the award does not vest unless the performance condition is met, we recognize expense if, and to the extent that, we estimate that achievement of the performance condition is probable. If we conclude that vesting is probable, we recognize expense from the date we reach this conclusion through the estimated vesting date.

We provide to employees who have rendered a certain number of years of service to Vertex and meet certain age requirements, partial or full acceleration of vesting of these equity awards, subject to certain conditions including a notification period, upon a termination of employment other than for cause. Approximately 5% of our employees were eligible for partial or full acceleration of any of their equity awards as of December 31, 2022. We recognize stock-based compensation expense related to these awards over a service period reflecting qualified employees' eligibility for partial or full acceleration of vesting.

Please refer to Note O, "Stock-based Compensation Expense," for tables displaying our stock-based compensation expense by type of award and by line item within our consolidated statements of operations.

Research and Development Expenses

Research and development expenses are comprised of costs we incur in performing research and development activities, including salary and benefits; stock-based compensation expense; outsourced services and other direct expenses, including clinical trial and pharmaceutical development costs; intangible asset impairment charges; and infrastructure costs, including facilities costs and depreciation expense. We recognize research and development expenses as incurred. We capitalize nonrefundable advance payments we make for research and development activities and expense the payments as the related goods are delivered or the related services are performed.

Acquired In-process Research and Development Expenses

Our research and development activities include upfront, contingent milestone, and other payments pursuant to our business development transactions, including collaborations, licenses of third-party technologies, and asset acquisitions. In-process research and development that is acquired in a transaction that does not qualify as a business combination under U.S. GAAP and that does not have an alternative future use is recorded to "Acquired in-process research and development expenses" in our consolidated statements of operations in the period in which it is acquired.

Inventories

We value our inventories at the lower-of-cost or net realizable value. We determine the cost of our inventories, which include amounts related to materials and manufacturing overhead, on a first-in, first-out basis. We perform an assessment of the recoverability of our capitalized inventory during each reporting period and write down any excess and obsolete inventories to their net realizable value in the period in which the impairment is first identified. Shipping and handling costs incurred for inventory purchases are capitalized and recorded upon sale in "Cost of sales" in our consolidated statements of operations. Shipping and handling costs incurred for product shipments are recorded as incurred in "Cost of sales" in our consolidated statements of operations.

We capitalize inventories produced in preparation for initiating sales of a product candidate when the related product candidate is considered to have a high likelihood of regulatory approval and the related costs are expected to be recoverable through sales of the inventories. In determining whether to capitalize such inventories, we evaluate, among other factors, information regarding the product candidate's safety and efficacy, the status of regulatory submissions and communications with regulatory authorities and the outlook for commercial sales, including the existence of current or anticipated competitive drugs and the availability of reimbursement. In addition, we evaluate risks associated with manufacturing the product candidate and the remaining shelf-life of the inventories.

Property and Equipment

Property and equipment are recorded at cost, net of accumulated depreciation. Depreciation expense is recorded using the straight-line method over the estimated useful life of the related asset generally as follows:

Description	Estimated Useful Life
Buildings and improvements	15 to 40 years
Laboratory equipment, other equipment and furniture	7 to 10 years
Leasehold improvements; assets under finance leases	The shorter of the useful life of the assets or the estimated remaining term of the associated lease
Computers and software	3 to 5 years

Maintenance and repairs to an asset that do not improve or extend its life are charged to operations. When assets are retired or otherwise disposed of, the assets and related accumulated depreciation are eliminated from the accounts and any resulting gain or loss is reflected in our consolidated statements of operations. We perform an assessment of the fair value of the assets if indicators of impairment are identified during a reporting period and record the assets at the lower of the net book value or the fair value of the assets.

We capitalize costs incurred to develop software for internal use during the application development stage. Amortization of capitalized internally developed software costs is recorded in depreciation expense over the useful life of the related asset.

Cloud Computing Service Contracts

We classify costs incurred to implement cloud computing service contracts as "Other assets" on our consolidated balance sheets. Amortization is recorded over the noncancellable term of the cloud computing service contract, plus any optional renewal periods that are reasonably certain to be exercised.

Leases

We determine whether an arrangement contains a lease at inception. If a lease is identified in an arrangement, we recognize a right-of-use asset and liability on our consolidated balance sheet and determine whether the lease should be classified as a finance or operating lease. We do not recognize assets or liabilities for leases with lease terms of less than 12 months.

A lease qualifies as a finance lease if any of the following criteria are met at the inception of the lease: (i) there is a transfer of ownership of the leased asset to Vertex by the end of the lease term, (ii) we hold an option to purchase the leased asset that we are reasonably certain to exercise, (iii) the lease term is for a major part of the remaining economic life of the leased asset, (iv) the present value of the sum of lease payments equals or exceeds substantially all of the fair value of the leased asset, or (v) the nature of the leased asset is specialized to the point that it is expected to provide the lessor no alternative use at the end of the lease term. All other leases are recorded as operating leases.

Finance and operating lease assets and liabilities are recognized at the lease commencement date based on the present value of the lease payments over the lease term using the discount rate implicit in the lease. If the rate implicit is not readily determinable, we utilize our incremental borrowing rate at the lease commencement date. Operating lease assets are further adjusted for prepaid or accrued lease payments. Operating lease payments are expensed using the straight-line method as an operating expense over the lease term. Finance lease assets are amortized to depreciation expense using the straight-line method over the shorter of the useful life of the related asset or the lease term. Finance lease payments are bifurcated into (i) a portion that is recorded as imputed interest expense and (ii) a portion that reduces the finance liability associated with the lease.

We do not separate lease and non-lease components for our real estate leases when determining which lease payments to include in the calculation of our lease assets and liabilities. Variable lease payments are expensed as incurred. If a lease includes an option to extend or terminate the lease, we reflect the option in the lease term if it is reasonably certain we will exercise the option.

Finance leases are recorded in “Property and equipment, net,” “Other current liabilities” and “Long-term finance lease liabilities,” and operating leases are recorded in “Operating lease assets,” “Other current liabilities” and “Long-term operating lease liabilities” on our consolidated balance sheets.

Income Taxes

Our provision for income taxes is accounted for under the asset and liability method and includes federal, state, local and foreign taxes.

Deferred tax assets and liabilities are recognized for the estimated future tax consequences of temporary differences between the financial statement carrying amounts and the income tax bases of assets and liabilities. Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the year in which the temporary differences are expected to be recovered or settled. A valuation allowance is applied against any net deferred tax asset if, based on the available evidence, it is more likely than not that some or all of the deferred tax assets will not be realized. On a periodic basis, we reassess the valuation allowance on our deferred income tax assets weighing positive and negative evidence to assess the recoverability of our deferred tax assets. We include, among other things, our recent financial performance and our future projections in this periodic assessment.

We record liabilities related to uncertain tax positions by prescribing a minimum recognition threshold and measurement attribute for the financial statement recognition and measurement of a tax position taken or expected to be taken in a tax return. We evaluate our uncertain tax positions on a quarterly basis and consider various factors, including, but not limited to, changes in tax law, the measurement of tax positions taken or expected to be taken in our tax returns, and changes in facts or circumstances related to a tax position. We adjust our liabilities to reflect any subsequent changes in the relevant facts and circumstances surrounding the uncertain positions. We accrue interest and penalties related to unrecognized tax benefits as a component of our “Provision for income taxes.”

As part of the U.S. Tax Cut and Jobs Act of 2017, we are subject to a territorial tax system, under which we must

establish an accounting policy to provide for tax on Global Intangible Low Taxed Income ("GILTI") earned by certain foreign subsidiaries. We have elected to treat the impact of GILTI as a current tax expense in our "Provision for income taxes."

Variable Interest Entities

We review each agreement pursuant to which we license technologies owned by a third party to determine whether or not we have a variable interest via the license agreement with the third party and if the variable interest is a variable interest in the third party as a whole and whether or not we are the primary beneficiary of that variable interest entity ("VIE"). If we determine we are the primary beneficiary of a VIE at the onset of a license agreement, it is treated as a business combination and we consolidate the financial statements of the VIE into our consolidated financial statements until we are no longer the primary beneficiary of the consolidated VIE, or no longer have a variable interest in the VIE. As of December 31, 2022 and 2021, we did not have any consolidated VIEs.

Fair Value of In-process Research and Development Assets and Contingent Payments

The present-value models we use to estimate the fair values of in-process research and development assets and contingent payments pursuant to third-party license agreements and acquisitions incorporate significant assumptions.

The fair value of our in-process research and development assets is determined using either the multi-period excess earnings or the relief from royalty methods of the income approach. Each method requires us to make: (i) assumptions regarding the probability of obtaining marketing approval for a product candidate; (ii) estimates of future cash flows from potential product sales with respect to a product candidate; and (iii) appropriate discount and tax rates. The multi-period excess earnings method also requires us to estimate the timing of and the expected costs to develop and commercialize a product candidate. The relief from royalty method also requires us to estimate the after-tax royalty savings expected from ownership of a product candidate that we acquired.

We base our estimates of the probability of achieving the milestones relevant to the fair value of contingent payments, which could include milestone, royalty and option payments, on industry data attributable to rare diseases and our knowledge of the programs and viability of the programs. Estimates included in the discounted cash flow models pertaining to contingent payments also include: (i) estimate regarding the timing of the relevant development and commercial milestones and royalties, (ii) and appropriate discount rates. We record any increases or decreases in the fair value of our contingent payments to "Change in fair value of contingent consideration" in our consolidated statements of operations. We record our contingent consideration liabilities at fair value on our consolidated balance sheets as "Other current liabilities" or "Other long-term liabilities" depending on when we estimate we will pay them. Please refer to Note E, "Fair Value Measurements," for further information.

In-process Research and Development Assets

We record the fair value of in-process research and development assets as of the transaction date of a business combination. Each of these assets is accounted for as an indefinite-lived intangible asset and is maintained on our consolidated balance sheets until either the underlying project is completed or the asset becomes impaired. If the asset becomes impaired or is abandoned, the carrying value of the related intangible asset is written down to its fair value, and an impairment charge is recorded in the period in which the impairment occurs. If a project is completed, the carrying value of the related intangible asset is amortized as a part of "Cost of sales" over the remaining estimated life of the asset beginning in the period in which the project is completed. In-process research and development assets are tested for impairment on an annual basis as of October 1, and more frequently if indicators are present or changes in circumstances suggest that impairment may exist.

Goodwill

The difference between the purchase price and the fair value of assets acquired and liabilities assumed in a business combination is allocated to goodwill. Goodwill is evaluated for impairment on an annual basis as of October 1, and more frequently if indicators are present or changes in circumstances suggest that impairment may exist. As noted in *Basis of Presentation* above, we have one operating segment, pharmaceuticals, which is our only reporting unit.

Hedging Activities

We recognize the fair value of hedging instruments that are designated and qualify as hedging instruments pursuant to U.S. GAAP, foreign currency forward contracts, as either assets or liabilities on our consolidated balance sheets. Changes in the fair value of these instruments are recorded each period in "Accumulated other comprehensive income" as unrealized gains and losses until the forecasted underlying transaction occurs. Unrealized gains and losses on these foreign currency forward contracts are included in "Prepaid expenses and other current assets" or "Other assets," and "Other current liabilities" or "Other long-term liabilities," respectively, on our consolidated balance sheets depending on the remaining period until their contractual maturity. Realized gains and losses for the effective portion of such contracts are recognized in "Product revenues, net" in our consolidated statement of operations in the same period that we recognize the product revenues that were impacted by the hedged foreign exchange rate changes. We classify the cash flows from hedging instruments in the same category as the cash flows from the hedged items.

Certain of our hedging instruments are subject to master netting arrangements to reduce the risk arising from such transactions with our counterparties. We present unrealized gains and losses on our foreign currency forward contracts on a gross basis within our consolidated balance sheets.

We also enter into foreign currency forward contracts with contractual maturities of less than one month designed to mitigate the effect of changes in foreign exchange rates on monetary assets and liabilities including intercompany balances. These contracts are not designated as hedging instruments pursuant to U.S. GAAP. Realized gains and losses for such contracts are recognized in "Other (expense) income, net" in our consolidated statements of operations each period.

Comprehensive Income

Comprehensive income consists of net income and other comprehensive income (loss), which includes foreign currency translation adjustments and unrealized gains and losses on foreign currency forward contracts and our available-for-sale debt securities. For purposes of comprehensive income disclosures, we record provisions for or benefits from income taxes related to the unrealized gains and losses on foreign currency forward contracts and our available-for-sale debt securities. We do not record provisions for or benefits from income taxes related to our cumulative translation adjustment, as we intend to permanently reinvest undistributed earnings in our foreign subsidiaries.

Foreign Currency Translation and Transactions

The majority of our operations occur in entities that have the U.S. dollar denominated as their functional currency. The assets and liabilities of our entities with functional currencies other than the U.S. dollar are translated into U.S. dollars at exchange rates in effect at the end of the year. Revenue and expense amounts for these entities are translated using the average exchange rates for the period. Changes resulting from foreign currency translation are included in "Accumulated other comprehensive income." Net foreign currency exchange transaction losses, which are included in "Other (expense) income, net" on our consolidated statements of operations, were $15.1 million, $13.9 million and $16.1 million for 2022, 2021 and 2020, respectively. These net foreign currency exchange losses are presented net of the impact of the foreign currency forward contracts designed to mitigate their effect on our consolidated statements of operations.

Share Repurchase Programs

Repurchases of our common stock are recorded as reductions to "Common Stock" and "Additional paid-in capital" pursuant to our established accounting policy. Repurchases in excess of the par value will be recorded as reductions to "Retained earnings" in the event that "Additional paid-in capital" is reduced to zero.

Net Income Per Common Share

Basic net income per common share is based upon the weighted-average number of common shares outstanding during the period. Diluted net income per common share utilizing the treasury-stock method is based upon the weighted-average number of common shares outstanding during the period plus additional weighted-average common equivalent shares outstanding during the period when the effect is dilutive. Potentially dilutive shares result from the assumed exercise of outstanding stock options and assumed vesting of restricted stock units (including performance-based restricted stock units) (the proceeds of which are then assumed to have been used to repurchase outstanding stock using the treasury-stock method).

Recently Adopted and Issued Accounting Standards

We have not been required to adopt any accounting standards that had a significant impact on our consolidated financial statements in the three years ended December 31, 2022. We do not expect any recently issued accounting standards to have a significant impact on our consolidated financial statements.

B. Acquired In-Process Research and Development and Other Arrangements

We have entered into numerous agreements with third parties to collaborate on research, development and commercialization programs, license technologies, or acquire assets. Our "Acquired in-process research and development expenses" included $115.5 million, $1.1 billion and $184.6 million in 2022, 2021 and 2020, respectively, related to upfront, contingent milestone, or other payments pursuant to our business development transactions, including collaborations, licenses of third-party technologies, and asset acquisitions that qualify as in-process research and development.

In-license Agreements

We have entered into several in-license agreements to advance and obtain access to technologies and services related to our research and early-development activities. We are generally required to make an upfront payment upon execution of our license agreements; development, regulatory and commercialization milestones payments upon the achievement of certain product research, development and commercialization objectives; and royalty payments on future sales, if any, of commercial products resulting from our collaborations.

Pursuant to the terms of our in-license agreements, our collaborators typically lead the discovery efforts and we lead all preclinical, development and commercialization activities associated with the advancement of any product candidates and fund all expenses.

We typically can terminate our in-license agreements by providing advance notice to our collaborators. Our license agreements may be terminated by either party for a material breach by the other, subject to notice and cure provisions. Unless earlier terminated, these license agreements generally remain in effect until the date on which the royalty term and all payment obligations with respect to all products in all countries have expired.

CRISPR Therapeutics AG - CRISPR-Cas9 Gene-editing Therapies

In 2015, we entered into a strategic collaboration, option and license agreement (the "CRISPR Agreement") with CRISPR Therapeutics AG and its affiliates ("CRISPR") to collaborate on the discovery and development of potential new treatments aimed at the underlying genetic causes of human diseases using CRISPR-Cas9 gene-editing technology. We had the exclusive right to license certain targets. In 2019, we elected to exclusively license three targets, including CF, pursuant to the CRISPR Agreement. For each of the three targets that we elected to license, CRISPR has the potential to receive up to an additional $410.0 million in development, regulatory and commercial milestones as well as royalties on net product sales.

In 2017, we entered into a joint development and commercialization agreement with CRISPR pursuant to the terms of the CRISPR Agreement (the "Original CTX001 JDCA"), under which we and CRISPR were co-developing and preparing to co-commercialize exagamglogene autotemcel ("exa-cel"), formerly known as CTX001, for the treatment of hemoglobinopathies, including treatments for sickle cell disease and transfusion-dependent beta thalassemia.

In the second quarter of 2021, we and CRISPR amended and restated the Original CTX001 JDCA (the "A&R JDCA"), pursuant to which the parties agreed to, among other things, (a) adjust the governance structure for the collaboration and adjust the responsibilities of each party thereunder; (b) adjust the allocation of net profits and net losses between the parties; and (c) exclusively license (subject to CRISPR's reserved rights to conduct certain activities) certain intellectual property rights to us relating to the products that may be researched, developed, manufactured and commercialized under such agreement.

Pursuant to the A&R JDCA, we lead global development, manufacturing and commercialization of exa-cel, with support from CRISPR. Subject to the terms and conditions of the A&R JDCA, we conduct all research, development, manufacturing and commercialization activities relating to the product candidates and products under the A&R JDCA (including exa-cel) throughout the world subject to CRISPR's reserved right to conduct certain activities.

In connection with the A&R JDCA, we made a $900.0 million upfront payment to CRISPR in the second quarter of 2021. We concluded that we did not have any alternative future use for the acquired in-process research and development and recorded this upfront payment to "Acquired in-process research and development expenses." CRISPR has the potential to receive an additional one-time $200.0 million milestone payment upon receipt of the first marketing approval of exa-cel from the U.S. Food and Drug Administration or the European Commission.

We and CRISPR shared equally all expenses incurred under the Original CTX001 JDCA. On July 1, 2021, the net profits and net losses incurred with respect to exa-cel pursuant to the A&R JDCA began to be allocated 60% to us and 40% to CRISPR, subject to certain adjustments, while all other product candidates and products continue to have net profits and net losses shared equally between the parties. We concluded that the Original CTX001 JDCA and the A&R JDCA are cost-sharing arrangements, which result in the net impact of the arrangements being recorded in "Total costs and expenses" within our consolidated statements of operations. During the three years ended December 31, 2022, we recognized the following amounts in total, not including amounts recorded to "Acquired in-process research and development expenses," related to these agreements:

	2022	2021	2020
		(in millions)	
Total expenses incurred under the Original CTX001 JDCA and A&R JDCA	$ 365.8	$ 230.4	$ 101.2
Vertex's share recognized in "Total costs and expenses" in our consolidated statements of operations	251.1	129.0	50.6

Entrada Therapeutics, Inc.

In December 2022, we announced a strategic collaboration and license agreement (the "Entrada Agreement") with Entrada Therapeutics, Inc. ("Entrada") focused on discovering and developing intracellular Endosomal Escape Vehicle (EEV) therapeutics for myotonic dystrophy type 1 ("DM1"). In February 2023, the Entrada Agreement closed upon, among other things, the satisfaction of customary closing conditions and the expiration of the waiting period under the Hart-Scott-Rodino Antitrust Improvements Act, resulting in no financial statement impact during 2022. The collaboration includes Entrada's program for DM1, ENTR-701, which is in late preclinical development. Upon closing, we made an upfront payment of approximately $224.0 million to Entrada, and purchased approximately $26.0 million of Entrada's common stock in connection with the Entrada Agreements. Entrada is eligible to receive up to an additional $485.0 million in research, development, regulatory and commercial milestones for any products that may result from the Entrada Agreement, as well as royalties on net product sales. We will account for the Entrada Agreement in the first quarter of 2023.

Verve Therapeutics, Inc.

In 2022, we entered into a strategic collaboration and license agreement with Verve Therapeutics, Inc. ("Verve") focused on discovering and developing an in vivo gene-editing program for a liver disease. Under the terms of the agreement, we made a $25.0 million upfront payment to Verve and also purchased $35.0 million of Verve's common stock in connection with the agreement. Verve is also eligible to receive up to $66.0 million in success payments, up to an additional $340.0 million in development, regulatory and commercial milestones for any products that may result from the collaboration agreement, and royalties on net product sales. We determined that substantially all the fair value of the collaboration agreement was attributable to in-process research and development and no substantive processes were acquired that would constitute a business. We concluded that there is no alternative future use for the acquired in-process research and development and recorded the upfront payment to "Acquired in-process research and development expenses." The investment in Verve's common stock is recorded at fair value on our consolidated balance sheet within "Marketable securities."

ApoLo1 Bio, LLC

In 2016, we entered into a strategic collaboration and license agreement with ApoLo1 Bio, LLC ("ApoLo1") related to our drug discovery efforts in APOL1-mediated kidney disease. In 2021, based on positive results from a Phase 2 proof-of-concept study of VX-147 in patients with APOL1-mediated focal segmental glomerulosclerosis, we paid ApoLo1 a $15.0 million milestone and exercised our $60.0 million option to buy-out all future development milestones, regulatory milestones, and future royalties on net product sales. We recorded these payments to "Acquired in-process research and development expenses" because we concluded that we did not have any alternative future use for the acquired in-process research and development.

Moderna, Inc.

In 2016, we entered into a strategic collaboration and licensing agreement with Moderna, Inc. ("Moderna"), pursuant to which the parties are seeking to identify and develop messenger ribonucleic acid ("mRNA") therapeutics encoding cystic fibrosis transmembrane conductance regulator for the treatment of CF.

In 2020, we entered into a new strategic collaboration and licensing agreement with Moderna (the "2020 Moderna Agreement") aimed at the discovery and development of lipid nanoparticles and mRNAs that can deliver gene-editing therapies to lung cells for the treatment of CF. Pursuant to the 2020 Moderna Agreement, we paid Moderna an upfront payment of $75.0 million and Moderna is eligible to receive up to $380.0 million in development, regulatory and commercial milestones as well as royalties on net product sales. We determined that substantially all the fair value of the 2020 Moderna Agreement was attributable to in-process research and development and no substantive processes were acquired that would constitute a business. We concluded that we did not have any alternative future use for the acquired in-process research and development and recorded the upfront payment to "Acquired in-process research and development expenses."

Asset Acquisition

Catalyst Biosciences, Inc.

In 2022, pursuant to an asset purchase agreement, we acquired from Catalyst Biosciences, Inc.'s a portfolio of protease medicines that target the complement system and related intellectual property, including CB 2782-PEG, which is a pre-clinical complement component 3 degrader program for geographic atrophy in dry age-related macular degeneration. We determined that substantially all the fair value acquired is concentrated in the CB-2782 PEG in-process research and development assets, which did not constitute a business, and for which we determined there was no alternative future use. As a result, we recorded our $60.0 million upfront payment to "Acquired in-process research and development expenses."

Additional In-License Agreements and Other Arrangements

In addition to the agreements described above, we recorded upfront, option and milestone payments totaling $30.5 million in 2022, $138.3 million in 2021 and $109.6 million in 2020 to "Acquired in-process research and development expenses" related to additional in-license agreements and other business development transactions that we do not consider to be individually significant to our consolidated financial statements. These payments included upfront payments of $31.0 million to Mammoth Biosciences, Inc. ("Mammoth") and $25.0 million to Arbor Biotechnologies, Inc. ("Arbor") in 2021, and $40.0 million to Skyhawk Therapeutics, Inc. ("Skyhawk") in 2020.

For Mammoth, Arbor, Skyhawk, and several other in-license agreements that we entered into prior to 2022 that are not individually significant to our consolidated financial statements, we determined that substantially all the fair value of each individual agreement was attributable to in-process research and development and no substantive processes were acquired that would constitute a business. We concluded that we did not have any alternative future use for the acquired in-process research and development associated with the agreements and recorded the upfront payments for these agreements to "Acquired in-process research and development expenses." Please refer to Note E, "Fair Value Measurements," and Note F, "Marketable Securities and Equity Investments," for further information regarding our investments in our collaborators.

Out-license Agreements

We have entered into licensing agreements pursuant to which we have out-licensed rights to certain product candidates to

third-party collaborators. Pursuant to these out-license agreements, our collaborators become responsible for all costs related to the continued development of such product candidates and obtain development and commercialization rights to these product candidates. Depending on the terms of the agreements, our collaborators may be required to make upfront payments, milestone payments upon the achievement of certain product research and development objectives and may also be required to pay royalties on future sales, if any, of commercial products resulting from the collaboration. The termination provisions associated with these collaborations are generally the same as those described above related to our in-license agreements.

Cystic Fibrosis Foundation

In 2004, we entered into a collaboration agreement with the Cystic Fibrosis Foundation, as successor in interest to the Cystic Fibrosis Foundation Therapeutics, Inc., to support research and development activities. Pursuant to the collaboration agreement, as amended, we have agreed to pay tiered royalties ranging from single digits to sub-teens on covered compounds first synthesized and/or tested during a research term on or before February 28, 2014, including ivacaftor, lumacaftor and tezacaftor and royalties ranging from low-single digits to mid-single digits on potential net sales of certain compounds first synthesized and/or tested between March 1, 2014 and August 31, 2016, including elexacaftor. We do not have any royalty obligations on compounds first synthesized and tested on or after September 1, 2016. For combination products, such as ORKAMBI, SYMDEKO/SYMKEVI and TRIKAFTA/KAFTRIO, sales are allocated equally to each of the active pharmaceutical ingredients in the combination product. We record our royalties payable to the Cystic Fibrosis Foundation to “Cost of sales.”

C. Business Combination

On September 27, 2022, we acquired all outstanding shares of ViaCyte, Inc. (“ViaCyte”), a privately held biotechnology company primarily focused on delivering novel stem cell-derived cell replacement therapies as a functional cure for type 1 diabetes, in exchange for $315.0 million. ViaCyte’s intellectual property and assembled workforce complement our ongoing programs and have the potential to produce therapies for patients with type 1 diabetes. We accounted for the transaction as a business combination, and allocated the purchase price to the following assets acquired and liabilities assumed:

	As of September 27, 2022 (in millions)
Cash and cash equivalents	$ 19.1
Goodwill	85.8
Intangible asset	216.6
Net other liabilities	(6.5)
Total purchase price	$ 315.0

The “Goodwill” represents the difference between the fair value of the consideration transferred and the fair value of the assets acquired and liabilities assumed. The goodwill is attributable to (i) the technological expertise in cell therapy of ViaCyte’s assembled workforce, (ii) the potential synergies from combining ViaCyte’s technology with our clinical development capabilities and (iii) the potential future benefits for other therapeutic programs that the acquired technology could be used for, but did not meet the definition of an in-process research and development asset. None of the goodwill is expected to be deductible for income tax purposes.

The “Intangible asset” is an in-process research and development asset of $216.6 million related to ViaCyte’s technology and intellectual property associated with stem cell differentiation and manufacturing. The fair value of the intangible asset was determined through a discounted cash flow analysis using the relief from royalty method, which estimated the cost savings associated with owning an asset instead of paying a royalty to the previous owner. The relief from royalty method utilized Level 3 fair value inputs including (i) estimated future product sales, which were calculated using, among other assumptions, an estimated probability of obtaining marketing approval for the asset, (ii) estimated after-tax royalty savings expected from ownership of the asset, and (iii) an appropriate discount and tax rate.

Our analysis of the fair value of certain assets acquired, including certain tax analyses, related to the ViaCyte business combination was preliminary as of September 30, 2022. In the fourth quarter of 2022, we recorded immaterial measurement period adjustments to goodwill and finalized our analysis of the fair value of assets acquired and liabilities assumed. In 2022, the financial results of ViaCyte did not have a material effect on our consolidated statement of operations.

D. Earnings Per Share

The following table sets forth the computation of basic and diluted net income per common share for the periods ended:

	2022	2021	2020
	(in millions, except per share amounts)		
Net income	$ 3,322.0	$ 2,342.1	$ 2,711.7
Basic weighted-average common shares outstanding	256.1	257.7	259.8
Effect of potentially dilutive securities:			
Stock options	1.4	1.1	1.8
Restricted stock units (including PSUs)	1.6	1.1	1.7
Employee stock purchase program	0.0	0.0	0.1
Diluted weighted-average common shares outstanding	259.1	259.9	263.4
Basic net income per common share	$ 12.97	$ 9.09	$ 10.44
Diluted net income per common share	$ 12.82	$ 9.01	$ 10.29

We did not include the securities in the following table in the computation of the diluted net income per common share because the effect would have been anti-dilutive during each period:

	2022	2021	2020
		(in millions)	
Stock options	0.0	0.7	0.3
Unvested restricted stock units (including PSUs)	0.2	0.4	0.3

E. Fair Value Measurements

The following fair value hierarchy is used to classify assets and liabilities based on observable inputs and unobservable inputs used to determine the fair value of our financial assets and liabilities:

Level 1:	Quoted prices in active markets for identical assets or liabilities. An active market for an asset or liability is a market in which transactions for the asset or liability occur with sufficient frequency and volume to provide pricing information on an ongoing basis.
Level 2:	Observable inputs other than Level 1 inputs. Examples of Level 2 inputs include quoted prices in active markets for similar assets or liabilities and quoted prices for identical assets or liabilities in markets that are not active.
Level 3:	Unobservable inputs based on our assessment of the assumptions that market participants would use in pricing the asset or liability.

Our investment strategy is focused on capital preservation. We invest in instruments that meet the credit quality standards outlined in our investment policy, which also limits the amount of credit exposure to any one issue or type of instrument. We maintain strategic investments separately from the investment policy that governs our other cash, cash

equivalents and marketable securities as described in Note F, “Marketable Securities and Equity Investments.” Additionally, we utilize foreign currency forward contracts intended to mitigate the effect of changes in foreign exchange rates on our consolidated statements of operations.

The following tables set forth our financial assets and liabilities subject to fair value measurements by level within the fair value hierarchy (and does not include $3.1 billion and $3.3 billion of cash as of December 31, 2022 and 2021, respectively):

	As of December 31, 2022				As of December 31, 2021			
		Fair Value Hierarchy				Fair Value Hierarchy		
	Total	Level 1	Level 2	Level 3	Total	Level 1	Level 2	Level 3
	(in millions)							
Financial instruments carried at fair value (asset positions):								
Cash equivalents:								
Money market funds	$ 5,162.6	$ 5,162.6	$ —	$ —	$ 3,478.1	$ 3,478.1	$ —	$ —
Time deposits	2,000.0	—	2,000.0	—	—	—	—	—
Corporate debt securities	5.8	—	5.8	—	—	—	—	—
Commercial paper	204.5	—	204.5	—	—	—	—	—
Marketable securities:								
Corporate equity securities	116.8	88.8	28.0	—	230.9	230.9	—	—
U.S. Treasury securities	—	—	—	—	86.4	86.4	—	—
Government-sponsored enterprise securities	127.1	127.1	—	—	69.0	69.0	—	—
Corporate debt securities	87.0	—	87.0	—	90.9	—	90.9	—
Commercial paper	55.8	—	55.8	—	252.7	—	252.7	—
Prepaid expenses and other current assets:								
Foreign currency forward contracts	47.5	—	47.5	—	44.5	—	44.5	—
Other assets:								
Foreign currency forward contracts	0.8	—	0.8	—	2.0	—	2.0	—
Total financial assets	$ 7,807.9	$ 5,378.5	$ 2,429.4	$ —	$ 4,254.5	$ 3,864.4	$ 390.1	$ —
Financial instruments carried at fair value (liability positions):								
Other current liabilities:								
Foreign currency forward contracts	$ (14.3)	$ —	$ (14.3)	$ —	$ (5.6)	$ —	$ (5.6)	$ —
Contingent consideration	(14.6)	—	—	(14.6)	—	—	—	—
Other long-term liabilities:								
Foreign currency forward contracts	(0.9)	—	(0.9)	—	(2.7)	—	(2.7)	—
Contingent consideration	(114.4)	—	—	(114.4)	(186.5)	—	—	(186.5)
Total financial liabilities	$ (144.2)	$ —	$ (15.2)	$ (129.0)	$ (194.8)	$ —	$ (8.3)	$ (186.5)

Please refer to Note F, “Marketable Securities and Equity Investments,” for the carrying amount and related unrealized gains (losses) by type of investment.

Fair Value of Corporate Equity Securities

We classify our investments in publicly traded corporate equity securities as “Marketable securities” on our consolidated balance sheets. Generally, our investments in the common stock of publicly traded companies are valued based on Level 1 inputs because they have readily determinable fair values. However, certain of our investments in publicly traded companies have been or continue to be valued based on Level 2 inputs due to transfer restrictions associated with these investments. Please refer to Note F, “Marketable Securities and Equity Investments,” for further information on these investments.

Fair Value of Contingent Consideration

In 2019, we acquired Exonics Therapeutics, Inc. (“Exonics”), a privately held company focused on creating

transformative gene-editing therapies to repair mutations that cause Duchenne muscular dystrophy and other severe neuromuscular diseases, including DM1. Our Level 3 contingent consideration liabilities are related to $678.3 million of development and regulatory milestones potentially payable to former Exonics equity holders. We base our estimates of the probability of achieving the milestones relevant to the fair value of contingent payments, which could include milestone, royalty and option payments, on industry data attributable to rare diseases and our knowledge of the programs and viability of the programs. The discount rates used in the valuation model for contingent payments, which were between 5.1% and 6.0% as of December 31, 2022, represent a measure of credit risk and market risk associated with settling the liabilities. Significant judgment is used in determining the appropriateness of these assumptions at each reporting period. Due to the uncertainties associated with development and commercialization of product candidates in the pharmaceutical industry and the effects of changes in other assumptions including discount rates, we expect our estimates regarding the fair value of contingent consideration to change in the future, resulting in adjustments to the fair value of our contingent consideration liabilities, and the effect of any such adjustments could be material.

The following table represents a rollforward of the fair value of our contingent consideration liabilities:

	Year Ended December 31, 2022
	(in millions)
Balance at December 31, 2021	$ 186.5
Decrease in fair value of contingent payments	(57.5)
Balance at December 31, 2022	$ 129.0

The decrease in fair value of contingent consideration during 2022 was primarily due to a revision to the scope of certain acquired gene-editing programs in the second quarter of 2022.

F. Marketable Securities and Equity Investments

A summary of our cash equivalents and marketable securities, which are recorded at fair value (and do not include $3.1 billion and $3.3 billion of cash as of December 31, 2022 and 2021, respectively), is shown below:

	As of December 31, 2022				As of December 31, 2021			
	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Fair Value	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Fair Value
	(in millions)							
Cash equivalents:								
Money market funds	$ 5,162.6	$ —	$ —	$ 5,162.6	$ 3,478.1	$ —	$ —	$ 3,478.1
Time deposits	2,000.0	—	—	2,000.0	—	—	—	—
Corporate debt securities	5.8	—	—	5.8	—	—	—	—
Commercial paper	204.5	—	—	204.5	—	—	—	—
Total cash equivalents	$ 7,372.9	$ —	$ —	$ 7,372.9	$ 3,478.1	$ —	$ —	$ 3,478.1
Marketable securities:								
U.S. Treasury securities	$ —	$ —	$ —	$ —	$ 86.6	$ —	$ (0.2)	$ 86.4
Government-sponsored enterprise securities	127.0	0.2	(0.1)	127.1	69.0	—	—	69.0
Corporate debt securities	87.2	—	(0.2)	87.0	91.1	—	(0.2)	90.9
Commercial paper	55.8	—	—	55.8	252.8	—	(0.1)	252.7
Total marketable debt securities	270.0	0.2	(0.3)	269.9	499.5	—	(0.5)	499.0
Corporate equity securities	104.4	30.9	(18.5)	116.8	69.4	167.1	(5.6)	230.9
Total marketable securities	$ 374.4	$ 31.1	$ (18.8)	$ 386.7	$ 568.9	$ 167.1	$ (6.1)	$ 729.9

Available-for-sale debt securities were classified on our consolidated balance sheets at fair value as follows:

	December 31,	
	2022	2021
	(in millions)	
Cash and cash equivalents	$ 5,372.9	$ 3,478.1
Marketable securities	157.7	499.0
Other assets	112.2	—
Total	$ 5,642.8	$ 3,977.1

Available-for-sale debt securities by contractual maturity were as follows:

	December 31,	
	2022	2021
	(in millions)	
Matures within one year	$ 5,530.6	$ 3,912.3
Matures after one year through five years	112.2	64.8
Total	$ 5,642.8	$ 3,977.1

We did not record any allowances for credit losses to adjust the fair value of available-for-sale debt securities in 2022, 2021 or 2020. Additionally, we did not record any realized gains or losses that were material to our consolidated statements of operations in 2022, 2021 or 2020.

We record changes in the fair value of our investments in corporate equity securities to “Other (expense) income, net” in our consolidated statements of operations. During the three years ended December 31, 2022, our net unrealized (losses) gains on corporate equity securities held at the conclusion of each period were as follows:

	2022	2021	2020
	(in millions)		
Net unrealized (losses) gains	$ (149.1)	$ 17.1	$ 136.2

In 2020, we sold the common stock of publicly traded companies, which were primarily sales of our investment in CRISPR, resulting in the following:

	2020
	(in millions)
Proceeds received	$ 437.6
Weighted-average cost basis	$ 103.3

In 2022 and 2021, we did not sell any common stock of publicly traded companies.

As of December 31, 2022, the carrying value of our equity investments without readily determinable fair values, which are recorded in “Other assets” on our consolidated balance sheets, was $98.6 million.

G. Accumulated Other Comprehensive Income (Loss)

The following table summarizes the changes in accumulated other comprehensive income (loss) by component:

	Foreign Currency Translation Adjustment	Unrealized Holding Gains (Losses), Net of Tax		Total
		On Available-For-Sale Debt Securities	On Foreign Currency Forward Contracts	
	(in millions)			
Balance as of December 31, 2019	$ (0.9)	$ 0.5	$ (1.6)	$ (2.0)
Other comprehensive loss before reclassifications	(14.7)	(0.2)	(54.5)	(69.4)
Amounts reclassified from accumulated other comprehensive income (loss)	—	—	2.9	2.9
Net current period other comprehensive loss	(14.7)	(0.2)	(51.6)	(66.5)
Balance as of December 31, 2020	$ (15.6)	$ 0.3	$ (53.2)	$ (68.5)
Other comprehensive income (loss) before reclassifications	2.0	(0.8)	59.7	60.9
Amounts reclassified from accumulated other comprehensive income (loss)	—	—	23.5	23.5
Net current period other comprehensive income (loss)	2.0	(0.8)	83.2	84.4
Balance as of December 31, 2021	$ (13.6)	$ (0.5)	$ 30.0	$ 15.9
Other comprehensive (loss) income before reclassifications	(11.4)	(3.3)	138.9	124.2
Amounts reclassified from accumulated other comprehensive income (loss)	—	3.7	(143.0)	(139.3)
Net current period other comprehensive (loss) income	(11.4)	0.4	(4.1)	(15.1)
Balance as of December 31, 2022	$ (25.0)	$ (0.1)	$ 25.9	$ 0.8

H. Hedging

Foreign currency forward contracts - Designated as hedging instruments

We maintain a hedging program intended to mitigate the effect of changes in foreign exchange rates for a portion of our forecasted product revenues denominated in certain foreign currencies. The program includes foreign currency forward contracts that are designated as cash flow hedges under U.S. GAAP having contractual durations from one to eighteen months. We recognize realized gains and losses for the effective portion of such contracts in “Product revenues, net” in our consolidated statements of operations in the same period that we recognize the product revenues that were impacted by the hedged foreign exchange rate changes.

We formally document the relationship between foreign currency forward contracts (hedging instruments) and forecasted product revenues (hedged items), as well as our risk management objective and strategy for undertaking various hedging activities, which includes matching all foreign currency forward contracts that are designated as cash flow hedges to forecasted transactions. We also formally assess, both at the hedge’s inception and on an ongoing basis, whether the foreign currency forward contracts are highly effective in offsetting changes in cash flows of hedged items on a prospective and retrospective basis. If we were to determine that a (i) foreign currency forward contract is not highly effective as a cash flow hedge, (ii) foreign currency forward contract has ceased to be a highly effective hedge or (iii) forecasted transaction is no longer probable of occurring, we would discontinue hedge accounting treatment prospectively. We measure effectiveness based on the change in fair value of the forward contracts and the fair value of the hypothetical foreign currency forward contracts with terms that match the critical terms of the risk being hedged. As of December 31, 2022, all hedges were

determined to be highly effective.

We consider the impact of our counterparties' credit risk on the fair value of the foreign currency forward contracts. As of December 31, 2022 and December 31, 2021, credit risk did not change the fair value of our foreign currency forward contracts.

The following table summarizes the notional amount in U.S. dollars of our outstanding foreign currency forward contracts designated as cash flow hedges under U.S. GAAP:

	As of December 31,	
	2022	2021
Foreign Currency	**(in millions)**	
Euro	$ 1,497.7	$ 1,364.5
British pound sterling	247.4	287.7
Canadian dollar	216.3	89.9
Australian dollar	174.9	96.3
Swiss Franc	65.2	54.1
Total foreign currency forward contracts	$ 2,201.5	$ 1,892.5

Foreign currency forward contracts - Not designated as hedging instruments

We also enter into foreign currency forward contracts with contractual maturities of less than one month, which are designed to mitigate the effect of changes in foreign exchange rates on monetary assets and liabilities, including intercompany balances. These contracts are not designated as hedging instruments under U.S. GAAP. We recognize realized gains and losses for such contracts in "Other (expense) income, net" in our consolidated statements of operations each period. As of December 31, 2022, the notional amount of our outstanding foreign currency forward contracts where hedge accounting under U.S. GAAP is not applied was $1.0 billion.

During the three years ended December 31, 2022, we recognized the following related to foreign currency forward contracts in our consolidated statements of operations:

	December 31,		
	2022	2021	2020
	(in millions)		
Designated as hedging instruments - Reclassified from AOCI			
Product revenues, net	$ 182.5	$ (30.0)	$ (3.7)
Not designated as hedging instruments			
Other (expense) income, net	$ (9.9)	$ (18.6)	$ 22.1
Total reported in the Consolidated Statements of Operations			
Product revenues, net	$ 8,930.7	$ 7,573.4	$ 6,202.8
Other (expense) income, net	$ (164.8)	$ 4.9	$ 296.6

The following table summarizes the fair value of our outstanding foreign currency forward contracts designated as cash flow hedges under U.S. GAAP included on our consolidated balance sheets:

As of December 31, 2022			
Assets		**Liabilities**	
Classification	**Fair Value**	**Classification**	**Fair Value**
	(in millions)		
Prepaid expenses and other current assets	$ 47.5	Other current liabilities	$ (14.3)
Other assets	0.8	Other long-term liabilities	(0.9)
Total assets	$ 48.3	Total liabilities	$ (15.2)

As of December 31, 2021			
Assets		**Liabilities**	
Classification	**Fair Value**	**Classification**	**Fair Value**
	(in millions)		
Prepaid expenses and other current assets	$ 44.5	Other current liabilities	$ (5.6)
Other assets	2.0	Other long-term liabilities	(2.7)
Total assets	$ 46.5	Total liabilities	$ (8.3)

As of December 31, 2022, we expect the amounts that are related to foreign exchange forward contracts designated as cash flow hedges under U.S. GAAP recorded in “Prepaid expenses and other current assets” and “Other current liabilities” to be reclassified to earnings within twelve months.

As discussed in “Note A, “Nature of Business and Accounting Policies,” we present the fair value of our foreign currency forward contracts on a gross basis within our consolidated balance sheets. The following table summarizes the potential effect of offsetting derivatives by type of financial instrument designated as cash flow hedges under U.S. GAAP on our consolidated balance sheets:

	As of December 31, 2022				
	Gross Amounts Recognized	**Gross Amounts Offset**	**Gross Amounts Presented**	**Gross Amounts Not Offset**	**Legal Offset**
Foreign currency forward contracts			**(in millions)**		
Total assets	$ 48.3	$ —	$ 48.3	$ (15.2)	$ 33.1
Total liabilities	(15.2)	—	(15.2)	15.2	—

	As of December 31, 2021				
	Gross Amounts Recognized	**Gross Amounts Offset**	**Gross Amounts Presented**	**Gross Amounts Not Offset**	**Legal Offset**
Foreign currency forward contracts			**(in millions)**		
Total assets	$ 46.5	$ —	$ 46.5	$ (8.3)	$ 38.2
Total liabilities	(8.3)	—	(8.3)	8.3	—

I. Inventories

"Inventories" consisted of the following:

	As of December 31,	
	2022	2021
	(in millions)	
Raw materials	$ 38.1	$ 42.4
Work-in-process	260.7	224.0
Finished goods	161.8	86.7
Total	$ 460.6	$ 353.1

J. Property and Equipment

"Property and equipment, net" consisted of the following:

	As of December 31,	
	2022	2021
	(in millions)	
Buildings and improvements	$ 903.1	$ 892.5
Laboratory equipment, other equipment and furniture	476.5	407.3
Leasehold improvements	410.9	363.5
Computers and software	312.1	293.7
Land	33.1	33.1
Total property and equipment, gross	2,135.7	1,990.1
Less: accumulated depreciation	(1,027.3)	(896.0)
Total property and equipment, net	$ 1,108.4	$ 1,094.1

We recorded depreciation expense of $148.3 million, $125.6 million and $109.5 million in 2022, 2021 and 2020, respectively, which includes our finance lease amortization.

K. Intangible Assets and Goodwill

Intangible Assets

As of December 31, 2022 and 2021, we had $603.6 million and $400.0 million, respectively, of in-process research and development intangible assets classified as "Intangible assets" on our consolidated balance sheets. In 2022, we recorded a $216.6 million in-process research and development intangible asset resulting from our acquisition of ViaCyte, which is described in Note C, "Business Combination," and recorded a $13.0 million impairment of an in-process research and development intangible asset to "Research and development expenses," due to a decision to revise the scope of certain acquired gene-editing programs.

Goodwill

As of December 31, 2022 and 2021, we had goodwill of $1.1 billion and $1.0 billion, respectively, on our consolidated balance sheets. During 2022, we recorded goodwill of $85.8 million related to our acquisition of ViaCyte, which is described in Note C, "Business Combination."

L. Additional Balance Sheet Detail

"Prepaid expenses and other current assets" consisted of the following:

	As of December 31,	
	2022	2021
	(in millions)	
Tax related prepaid and receivables	$ 319.8	$ 358.6
Prepaid expenses	111.8	83.5
Fair value of cash flow hedges	47.5	44.5
Other	74.4	59.2
Total	$ 553.5	$ 545.8

"Accrued expenses" consisted of the following:

	As of December 31,	
	2022	2021
	(in millions)	
Product revenue accruals	$ 1,300.8	$ 847.4
Payroll and benefits	246.5	191.3
Research, development and commercial contract costs	198.7	171.6
Royalty payable	215.0	200.4
Tax related accruals	123.3	211.3
Other	42.4	56.6
Total	$ 2,126.7	$ 1,678.6

"Other current liabilities" consisted of the following:

	As of December 31,	
	2022	2021
	(in millions)	
Contract liabilities	$ 159.6	$ 171.7
Finance lease liabilities	40.8	46.9
Operating lease liabilities	48.6	33.3
Other	62.5	16.5
Total	$ 311.5	$ 268.4

"Other long-term liabilities" consisted of the following:

	As of December 31,	
	2022	2021
	(in millions)	
Tax related liabilities	$ 452.8	$ —
Contingent consideration	114.4	186.5
Other	118.6	116.8
Total	$ 685.8	$ 303.3

Cash, Cash Equivalents and Restricted Cash Presented in Consolidated Statements of Cash Flows

The cash, cash equivalents and restricted cash balances at the beginning and ending of each period presented in our consolidated statements of cash flows consisted of the following:

	As of December 31,			
	2022	2021	2020	2019
	(in millions)			
Cash and cash equivalents	$ 10,504.0	$ 6,795.0	$ 5,988.2	$ 3,109.3
Prepaid expenses and other current assets	8.0	5.1	0.7	8.0
Other assets	—	—	—	3.4
Cash, cash equivalents and restricted cash per consolidated statements of cash flows	$ 10,512.0	$ 6,800.1	$ 5,988.9	$ 3,120.7

Our restricted cash, if any, is included in “Prepaid expenses and other current assets” and “Other assets” on our consolidated balance sheets.

Cloud Computing Service Contracts

As of December 31, 2022, “Other assets” included $40.2 million related to costs incurred to implement cloud computing service contracts. The amounts associated with cloud computing service contracts were not material to either our consolidated balance sheet as of December 31, 2021 or our consolidated statements of operations for 2022, 2021 and 2020.

M. Leases

Finance Leases

Our finance lease assets and liabilities primarily relate to our corporate headquarters in Boston and research site in San Diego (the “Buildings”). These Buildings are classified as finance leases because the present value of the sum of the lease payments associated with the Buildings exceeds substantially all of the fair value of the Buildings. We also have an outstanding finance lease for land.

Corporate Headquarters

In 2011, we entered into two lease agreements, pursuant to which we lease approximately 1.1 million square feet of office and laboratory space in two buildings in Boston, Massachusetts for a term of 15 years. Base rent payments commenced in 2013 and will continue through December 2028. We utilize this initial period as our lease term. We have an option to extend the lease term for an additional ten years.

San Diego Lease

In 2015, we entered into a lease agreement pursuant to which we lease approximately 170,000 square feet of office and laboratory space in San Diego, California for a term of 16 years. Base rent payments commenced in 2019 and will continue through May 2034. We utilize this initial period as our lease term. We have an option to extend the lease term for up to two additional five-year terms.

Operating Leases

Our operating leases relate to our real estate leases that are not classified as finance leases.

Jeffrey Leiden Center for Cell and Genetic Therapies

In 2019, we entered into an agreement to lease approximately 269,000 square feet of office and laboratory space near our corporate headquarters in Boston, Massachusetts for a term of 16 years. Base rent payments commenced in 2021 and will

continue through November 2036. We utilize the initial period as our lease term. We have an option to extend the lease term for up to two additional ten-year periods.

Please refer to our accounting policy, *Leases*, in Note A, "Nature of Business and Accounting Policies," for further information on the accounting treatment for our finance and operating leases.

Aggregate Lease Information

The components of lease cost recorded in our consolidated statements of operations were as follows:

	2022	2021	2020
		(in millions)	
Operating lease cost	$ 35.3	$ 33.9	$ 23.1
Finance lease cost			
Amortization of leased assets	51.0	51.9	51.2
Interest on lease liabilities	43.5	47.4	50.2
Variable lease cost	39.8	33.6	30.8
Sublease income	(2.7)	(0.4)	(4.0)
Net lease cost	$ 166.9	$ 166.4	$ 151.3

Our variable lease cost during 2022, 2021 and 2020 primarily related to operating expenses, taxes and insurance associated with our finance leases.

Our leases are included on our consolidated balance sheets as follows:

	As of December 31,	
	2022	2021
	(in millions)	
Finance leases		
Property and equipment, net	$ 315.5	$ 400.1
Total finance lease assets	$ 315.5	$ 400.1
Other current liabilities	$ 40.8	$ 46.9
Long-term finance lease liabilities	430.8	509.8
Total finance lease liabilities	$ 471.6	$ 556.7
Operating leases		
Operating lease assets	$ 347.4	$ 330.3
Total operating lease assets	$ 347.4	$ 330.3
Other current liabilities	$ 48.6	$ 33.3
Long-term operating lease liabilities	379.5	377.4
Total operating lease liabilities	$ 428.1	$ 410.7

Maturities of our finance and operating lease liabilities as of December 31, 2022 were as follows:

Year	Finance Leases	Operating Leases	Total
		(in millions)	
2023	$ 76.0	$ 58.4	$ 134.4
2024	88.7	44.3	133.0
2025	89.0	40.2	129.2
2026	89.3	39.4	128.7
2027	89.7	35.3	125.0
Thereafter	233.6	273.7	507.3
Total lease payments	666.3	491.3	1,157.6
Less: amount representing interest	(194.7)	(63.2)	(257.9)
Present value of lease liabilities	$ 471.6	$ 428.1	$ 899.7

The weighted-average remaining lease terms and discount rates related to our leases were as follows:

	As of December 31,	
	2022	2021
Weighted-average remaining lease term (in years)		
Finance leases	10.60	10.73
Operating leases	11.57	12.81
Weighted-average discount rate		
Finance leases	8.36 %	8.11 %
Operating leases	2.46 %	2.19 %

Supplemental cash flow information related to our leases was as follows:

	2022	2021	2020
		(in millions)	
Cash paid for amounts included in the measurement of lease liabilities			
Operating cash flows from operating leases	$ 50.8	$ 21.5	$ 16.3
Operating cash flows from finance leases	$ 42.5	$ 46.2	$ 48.9
Financing cash flows from finance leases	$ 85.5	$ 47.0	$ 42.3
Right-of-use assets obtained in exchange for lease obligations			
Operating leases	$ 58.6	$ 36.3	$ 293.6
Finance leases	$ —	$ —	$ 33.1

N. Common Stock, Preferred Stock and Equity Plans

Common Stock and Preferred Stock

We are authorized to issue 500.0 million shares of common stock. Holders of common stock are entitled to one vote per share. Holders of common stock are entitled to receive dividends, if and when declared by our Board of Directors, and to share ratably in our assets legally available for distribution to our shareholders in the event of liquidation. Holders of common stock have no preemptive, subscription, redemption or conversion rights. The holders of common stock do not have cumulative voting rights.

We are authorized to issue 1.0 million shares of preferred stock in one or more series and to fix the powers, designations, preferences and relative participating, option or other rights thereof, including dividend rights, conversion rights, voting rights, redemption terms, liquidation preferences and the number of shares constituting any series, without any further vote or action by our shareholders. As of December 31, 2022 and 2021, we had no shares of preferred stock issued or outstanding.

Share Repurchase Programs

In July 2019, our Board of Directors approved a share repurchase program (the "2019 Share Repurchase Program"), pursuant to which we repurchased $500.0 million of our common stock in 2019 and 2020. In 2020, we repurchased 2.1 million shares of our common stock under the 2019 Share Repurchase Program for an aggregate of $464.0 million.

In November 2020, our Board of Directors approved a share repurchase program (the "2020 Share Repurchase Program"), pursuant to which we repurchased $500.0 million of our common stock in 2020 and 2021. In 2021 and 2020, we repurchased 2.0 million and 0.3 million shares, respectively, of our common stock under the 2020 Share Repurchase Program for an aggregate of $424.9 million and $75.1 million, respectively.

In June 2021, our Board of Directors approved a share repurchase program (the "2021 Share Repurchase Program"), pursuant to which we were authorized to repurchase up to $1.5 billion of our common stock by December 31, 2022. In 2021, we repurchased 5.3 million shares of our common stock under the 2021 Share Repurchase Program for an aggregate of $1.0 billion. On December 31, 2022, the 2021 Share Repurchase Program expired with $499.7 million of the authorization remaining.

In February 2023, our Board of Directors approved a share repurchase program (the "2023 Share Repurchase Program"), pursuant to which we are authorized to repurchase up to $3.0 billion of our common stock. The 2023 Share Repurchase Program does not have an expiration date and can be discontinued at any time. We expect to fund repurchases of our common stock through a combination of cash on hand and cash generated by operations.

Stock and Option Plans

The purpose of each of our stock and option plans is to attract, retain and motivate our employees, consultants and directors. Awards granted under these plans can be nonstatutory stock options ("NSOs"), incentive stock options ("ISOs"), restricted stock units ("RSUs") including performance-based RSUs ("PSUs"), restricted stock ("RSs"), or other equity-based awards, as specified in the individual plans.

Shares issued under all of our plans are funded through the issuance of new shares. The following table contains information about our equity plans:

Title of Plan	Group Eligible	Type of Award Granted	As of December 31, 2022	
			Awards Outstanding	Additional Awards Authorized for Grant
			(in thousands)	
2013 Stock and Option Plan	Employees, Non-employee Directors and Consultants	NSO, RS, RSU and PSU	6,553	19,695
2006 Stock and Option Plan	Employees, Non-employee Directors and Consultants	NSO, RS and RSU	114	—
		Total	6,667	19,695

All options granted under our 2013 Stock and Option Plan ("2013 Plan") and 2006 Stock and Option Plan ("2006 Plan") were granted with an exercise price equal to the fair value of the underlying common stock on the date of grant. As of December 31, 2022, we are only authorized to make new equity awards under our 2013 Plan. Under the 2013 Plan, no stock options can be awarded with an exercise price less than the fair market value on the date of grant. In 2022, our shareholders approved an increase in the number of shares authorized for issuance pursuant to the 2013 Stock and Option Plan of 13.5 million shares.

In each of the three years ended December 31, 2022, we issued stock options to our non-employee directors. The grant date for our stock options was the date the award was approved by our Board of Directors or the date new directors were elected to our Board of Directors. All options awarded under our stock and option plans expire not more than 10 years from the grant date.

Stock Options

The following table summarizes information related to the outstanding and exercisable options during the year ended December 31, 2022:

	Stock Options	Weighted-average Exercise Price	Weighted-average Remaining Contractual Life	Aggregate Intrinsic Value
	(in thousands)	(per share)	(in years)	(in millions)
Outstanding at December 31, 2021	3,611	$ 141.76		
Granted	20	$ 276.17		
Exercised	(1,087)	$ 133.50		
Forfeited	(17)	$ 181.49		
Expired	—	$ —		
Outstanding at December 31, 2022	2,527	$ 146.11	4.67	$ 355.6
Exercisable at December 31, 2022	2,446	$ 144.94	4.61	$ 347.1

The aggregate intrinsic value in the table above represents the total pre-tax amount, net of exercise price, that would have been received by option holders if all option holders had exercised all options with an exercise price lower than the market price on the last business day of 2022, which was $286.86 based on the average of the high and low price of our common stock on that date.

The total intrinsic value (the amount by which the fair market value exceeded the exercise price) of stock options exercised during 2022, 2021 and 2020 was $157.2 million, $43.0 million and $255.0 million, respectively. The total cash we received as a result of employee stock option exercises during 2022, 2021 and 2020 was $144.6 million, $64.2 million and $228.2 million, respectively.

The following table summarizes information about stock options outstanding and exercisable as of December 31, 2022:

	Options Outstanding			Options Exercisable	
Range of Exercise Prices	Number Outstanding	Weighted-average Remaining Contractual Life	Weighted-average Exercise Price	Number Exercisable	Weighted-average Exercise Price
	(in thousands)	(in years)	(per share)	(in thousands)	(per share)
$45.11–$100.00	689	3.13	$ 86.05	689	$ 86.05
$100.01–$150.00	286	2.58	$ 123.17	286	$ 123.17
$150.01–$200.00	1,482	5.61	$ 173.26	1,401	$ 172.78
$200.01–$286.27	70	8.33	$ 256.44	70	$ 256.44
Total	2,527	4.67	$ 146.11	2,446	$ 144.94

Restricted Stock Units (excluding PSUs) and Restricted Stock

The following table summarizes our restricted stock unit activity during the year ended December 31, 2022:

	Restricted Stock Units (excluding PSUs)	
	Number of Shares	Weighted-average Grant-date Fair Value
	(in thousands)	(per share)
Unvested at December 31, 2021	2,909	$ 213.17
Granted	1,710	$ 258.39
Vested	(1,445)	$ 209.08
Cancelled	(261)	$ 228.88
Unvested at December 31, 2022	2,913	$ 240.54

The total fair value of restricted stock units and restricted stock that vested during 2022, 2021 and 2020 (measured based on the market price of our common stock on the date of vesting) was $372.5 million, $281.1 million and $391.7 million, respectively.

Performance-based RSUs (PSUs)

The potential range of shares issuable pursuant to our PSU awards range from 0% to 200% of the target shares based on financial and non-financial measures. Fifty percent of PSUs that could be earned have a one-year performance period with the amount actually earned dependent upon our financial performance and with vesting of the earned shares in three equal installments over a three-year period. The remaining 50% of PSUs that could be earned have a three-year performance period with the amount actually earned dependent upon the achievement of multiple clinical development milestones and with the earned shares cliff vesting at the end of the three-year performance period.

The following table summarizes our PSU activity during the year ended December 31, 2022:

	Performance-Based RSU	
	Number of Units	Weighted-average Grant-date Fair Value
	(in thousands)	(per share)
Unvested at December 31, 2021 (1)	1,078	$ 215.85
Granted (2)	608	$ 247.26
Vested	(426)	$ 203.75
Cancelled	(33)	$ 222.16
Unvested at December 31, 2022	1,227	$ 226.75

(1) “Unvested” represents our PSUs at target to the extent performance has not been certified plus the actual number of shares that continue to be subject to service conditions for which the performance has been achieved and certified.

(2) “Granted” represents (i) the target number of shares issuable for grants during 2022 and (ii) any change in the number of shares issuable pursuant to outstanding PSUs based on performance certification during 2022.

The total fair value of PSUs that vested during 2022, 2021 and 2020 (measured on the date of vesting) was $98.7 million, $92.2 million and $138.5 million, respectively.

Employee Stock Purchase Plan

We have an employee stock purchase plan (the “ESPP”). The ESPP permits eligible employees to enroll in a twelve-month offering period comprising two six-month purchase periods. Participants may purchase shares of our common stock, through payroll deductions, at a price equal to 85% of the fair market value of the common stock on the first day of the applicable twelve-month offering period, or the last day of the applicable six-month purchase period, whichever is lower. Purchase dates under the ESPP occur on or about May 14 and November 14 of each year. As of December 31, 2022, there were 1.5 million shares of common stock authorized for issuance pursuant to the ESPP.

In 2022, the following shares were issued to employees under the ESPP:

	Year Ended December 31, 2022
Number of shares (in thousands)	261
Average price paid per share	$ 161.74

Employee Benefits

We have a 401(k) retirement plan (the “Vertex 401(k) Plan”) in which substantially all of our permanent U.S. employees are eligible to participate. Participants may contribute up to 60% of their annual compensation to the Vertex 401(k) Plan, subject to statutory limitations. We may declare discretionary matching contributions to the Vertex 401(k) Plan. We pay matching contributions in the form of cash. In 2022, 2021 and 2020, we contributed approximately $27.5 million, $21.8 million and $19.2 million to the plan, respectively.

O. Stock-based Compensation Expense

We recognize share-based payments to employees as compensation expense using the fair value method. The fair value of stock options and shares purchased pursuant to the ESPP is calculated using the Black-Scholes option pricing model. The fair value of restricted stock units, including PSUs, is based on the intrinsic value on the date of grant. Stock-based compensation, measured at the grant date based on the fair value of the award, is typically recognized as expense ratably over the requisite service period.

The effect of stock-based compensation expense during the three years ended December 31, 2022 was as follows:

	2022	2021	2020
		(in millions)	
Stock-based compensation expense by line item:			
Cost of sales	$ 9.4	$ 6.3	$ 5.6
Research and development expenses	297.9	268.3	262.7
Selling, general and administrative expenses	184.0	166.8	161.2
Total stock-based compensation expense included in costs and expenses	491.3	441.4	429.5
Income tax effect	(144.1)	(82.9)	(147.0)
Total stock-based compensation included in costs and expenses, net of tax	$ 347.2	$ 358.5	$ 282.5

The stock-based compensation expense by type of award during the three years ended December 31, 2022 was as follows:

	2022	2021	2020
		(in millions)	
Stock-based compensation expense by type of award:			
Restricted stock units (including PSUs)	$ 456.1	$ 384.3	$ 360.4
Stock options	17.6	36.8	59.7
ESPP share issuances	16.7	24.4	13.0
Stock-based compensation expense related to inventories	0.9	(4.1)	(3.6)
Total stock-based compensation expense included in costs and expenses	$ 491.3	$ 441.4	$ 429.5

We capitalize a portion of our stock-based compensation expense to inventories, all of which is attributable to employees who support the manufacturing of our products.

The following table sets forth our unrecognized stock-based compensation expense as of December 31, 2022, by type of award and the weighted-average period over which that expense is expected to be recognized:

	As of December 31, 2022	
	Unrecognized Expense	Weighted-average Recognition Period
	(in millions)	(in years)
Type of award:		
Restricted stock units (including PSUs)	$ 477.9	1.93
Stock options	2.2	0.42
ESPP share issuances	11.3	0.61
Total unrecognized stock-based compensation expense	$ 491.4	

Stock Options

In each of the three years ended December 31, 2022, we issued stock options to our non-employee directors. We use the Black-Scholes option pricing model to estimate the fair value of stock options at the grant date. The Black-Scholes option pricing model uses the option exercise price as well as estimates and assumptions related to the expected price volatility of our stock, the rate of return on risk-free investments, the expected period during which the options will be outstanding, and the expected dividend yield for our stock to estimate the fair value of a stock option on the grant date. The options granted during 2022, 2021 and 2020 had a weighted-average grant-date fair value per share of $89.65, $65.94 and $88.37,

respectively.

The fair value of each option granted during 2022, 2021 and 2020 was estimated on the date of grant using the Black-Scholes option pricing model with the following weighted-average assumptions:

	2022	2021	2020
Stock options granted	20,079	27,302	22,636
Expected stock price volatility	34.03%	35.03%	35.87%
Risk-free interest rate	2.93%	0.86%	0.43%
Expected term of options (in years)	4.36	4.50	4.67
Expected annual dividends	—	—	—

The weighted-average valuation assumptions were determined as follows:

- *Expected stock price volatility:* Expected stock price volatility is calculated using the trailing one-month average of daily implied volatilities prior to the grant date. Implied volatility is based on options to purchase our stock with remaining terms of greater than one year that are regularly traded in the market.
- *Risk-free interest rate:* We base the risk-free interest rate on the interest rate payable on U.S. Treasury securities in effect at the time of grant for a period that is commensurate with the assumed expected option term.
- *Expected term of options:* The expected term of options represents the period of time options are expected to be outstanding. We use historical data to estimate employee exercise and post-vest termination behavior. We believe that all groups of employees exhibit similar exercise and post-vest termination behavior and therefore do not stratify employees into multiple groups in determining the expected term of options.
- *Expected annual dividends:* The estimate for annual dividends is $0.00 because we have not historically paid, and do not intend for the foreseeable future to pay, a dividend.

Restricted Stock Units and Performance-based Restricted Stock Units

We award restricted stock units with service conditions, which are generally the vesting periods of the awards.

As described in Note N, “Common Stock, Preferred Stock and Equity Plans,” we grant PSUs to certain members of senior management. Our financial-based PSUs vest in three equal installments over a three-year period and are expensed ratably over that same period based upon an assessment of the likely level of achievement. Our non-financial based PSUs cliff vest at the end of the three-year performance period and are expensed on a straight-line basis over that same period based upon an assessment of the likely level of achievement.

Employee Stock Purchase Plan

The weighted-average fair value of each purchase right granted during 2022, 2021 and 2020 was $79.36, $51.71 and $65.88, respectively. The following table reflects the weighted-average assumptions used in the Black-Scholes option pricing model for 2022, 2021 and 2020:

	2022	2021	2020
Expected stock price volatility	33.55%	34.06%	37.70%
Risk-free interest rate	4.05%	0.05%	0.11%
Expected term (in years)	0.71	0.69	0.71
Expected annual dividends	—	—	—

The weighted-average assumptions used in our Black-Scholes option pricing model were determined utilizing calculations similar to those described under *Stock Options* above.

P. Income Taxes

We are subject to U.S. federal, state, and foreign income taxes. The components of income before provision for income taxes during the three years ended December 31, 2022, consisted of the following:

	2022	2021	2020
		(in millions)	
United States	$ 3,257.0	$ 2,030.7	$ 2,885.4
Foreign	975.4	699.7	231.5
Income before provision for income taxes	$ 4,232.4	$ 2,730.4	$ 3,116.9

The components of our provision for income taxes during the three years ended December 31, 2022, consisted of the following:

	2022	2021	2020
		(in millions)	
Current taxes:			
Federal	$ 779.0	$ 374.9	$ 71.4
State	34.9	26.5	18.9
Foreign	372.4	141.5	37.6
Total current taxes	1,186.3	542.9	127.9
Deferred taxes:			
Federal	(404.0)	(36.9)	510.2
State	(11.0)	(19.3)	6.7
Foreign	139.1	(98.4)	(239.6)
Total deferred taxes	(275.9)	(154.6)	277.3
Provision for income taxes	$ 910.4	$ 388.3	$ 405.2

Unremitted Earnings

As of December 31, 2022, we are treating all our foreign subsidiaries earnings to be indefinitely reinvested. Upon repatriation of the indefinitely reinvested earnings, in the form of dividends or otherwise, we could be subject to U.S. federal withholding taxes payable to various foreign countries and income taxes in certain states. We do not provide for deferred taxes on the excess of financial statement reporting over the tax basis of our investments in our foreign subsidiaries as they are deemed to be essentially permanent in duration. These permanently reinvested basis differences could reverse if we sell our foreign subsidiaries or various other events occur, none of which were considered probable as of December 31, 2022. The tax liabilities described above would not be material to our consolidated financial statements.

Effective Tax Rate Reconciliation

A reconciliation between the U.S. federal statutory rate of 21% and our effective tax rate is as follows:

	2022	2021	2020
Federal statutory tax rate	21.0 %	21.0 %	21.0 %
State taxes, net of federal benefit	0.6 %	0.8 %	0.6 %
Foreign income tax rate differential	(0.3)%	(0.3)%	0.2 %
U.S. tax on foreign earnings, net of credits	1.9 %	0.7 %	2.7 %
Foreign derived intangible income deduction	(1.4)%	(0.8)%	(0.2)%
Tax credits	(2.2)%	(6.4)%	(1.8)%
Tax rate change	0.0 %	(3.5)%	(1.2)%
Stock compensation (benefit), shortfalls and cancellations	(0.8)%	0.0 %	(2.3)%
Long-term intercompany receivable write-off	— %	— %	(1.7)%
Uncertain tax positions	2.7 %	2.0 %	1.3 %
Intra-entity transfer of intellectual property rights	— %	— %	(6.7)%
Other	0.0 %	0.7 %	1.1 %
Effective tax rate	21.5 %	14.2 %	13.0 %

Our 21.5% effective tax rate for 2022 was higher than the U.S. statutory rate primarily due to an increase in our unrecognized tax benefit liabilities associated with intercompany transfer pricing matters offset by excess tax benefits related to stock-based compensation, tax credits and changes in our estimated to prior-year tax liabilities.

Our 14.2% effective tax rate for 2021 was lower than the U.S. statutory rate primarily due to discrete tax benefits of (i) $94.8 million associated with an increase in the United Kingdom's (the "U.K.") corporate tax rate from 19% to 25%, which was enacted in June 2021 and will become effective in April 2023, and (ii) $44.1 million resulting from an R&D tax credit study that we completed in 2021.

Our 13.0% effective tax rate for 2020 was lower than the U.S. statutory rate primarily due to (i) a discrete tax benefit of $209.0 million associated with an intra-entity transfer of intellectual property rights to our U.K. entity, (ii) a discrete tax benefit associated with the write-off of a long-term intercompany receivable, (iii) a discrete tax benefit associated with an increase in the U.K.'s corporate tax rate from 17% to 19%, which was enacted and became effective in July 2020, and (iv) excess tax benefits related to stock-based compensation. The impact of these items was partially offset by U.S. income tax on foreign earnings.

Deferred Tax Assets and Liabilities

Deferred tax assets and liabilities are determined based on the difference between financial statement and tax bases using enacted tax rates in effect for the year in which the differences are expected to reverse. The components of the deferred taxes were as follows:

	As of December 31,	
	2022	2021
	(in millions)	
Deferred tax assets:		
Net operating loss	$ 77.4	$ 106.6
Tax credit carryforwards	223.0	202.4
Intangible assets	738.5	802.8
Stock-based compensation	124.4	94.6
Finance lease liabilities	94.9	103.4
Operating lease assets	79.6	81.1
R&D capitalization	438.3	—
Other	69.2	90.3
Gross deferred tax assets	1,845.3	1,481.2
Valuation allowance	(237.8)	(220.4)
Total deferred tax assets	1,607.5	1,260.8
Deferred tax liabilities:		
Property and equipment	(139.8)	(118.2)
Acquired intangibles	(130.5)	(87.0)
Operating lease liabilities	(63.1)	(64.8)
Other	(27.2)	(56.3)
Total deferred tax liabilities	(360.6)	(326.3)
Net deferred tax assets	$ 1,246.9	$ 934.5

On a periodic basis, we reassess the valuation allowance on our deferred income tax assets, weighing positive and negative evidence to assess the recoverability of our deferred tax assets. As of December 31, 2022, we maintained a valuation allowance of $237.8 million related primarily to U.S. state tax attributes.

In addition to deferred tax assets and liabilities, we have recorded deferred charges related to intra-entity sales of inventory. As of December 31, 2022 and 2021, the total deferred charges were $195.1 million and $225.4 million, respectively.

As of December 31, 2022, we had net operating loss (“NOL”) carryforwards of $65.3 million, which are subject to annual utilization limitations for U.S. federal income tax purposes. In 2027, our definite lived U.S. federal NOLs of $19.8 million will begin to expire, while the remaining portion may be carried forward indefinitely. For U.S. state income tax purposes, we had NOL carryforwards of $553.8 million and tax credit carryforwards of $273.5 million. The state NOL and tax credit carryforwards begin to expire in 2023. For foreign income tax purposes, we had NOL carryforwards of $151.4 million and tax credit carryforwards of $21.5 million. The foreign NOL carryforwards may be carried forward indefinitely, with the exception of $70.0 million that will expire in 2041. The foreign tax credit carryforwards will begin to expire in 2026.

Unrecognized Tax Benefits

Unrecognized tax benefits during the three years ended December 31, 2022 were as follows:

	2022	2021	2020
		(in millions)	
Balance at beginning of the period	$ 147.2	$ 86.6	$ 33.9
Increases related to current period tax positions	128.3	42.0	26.7
Increases related to prior period tax positions	205.3	19.9	26.7
Decreases related to prior period tax positions	(14.4)	—	—
Statute of limitations expiration	(4.5)	(1.3)	(0.7)
Foreign currency translation adjustment	(2.3)	—	—
Balance at end of period	$ 459.6	$ 147.2	$ 86.6

During 2022, we increased our gross unrecognized tax benefits by $312.4 million, primarily associated with intercompany transfer pricing matters. This unrecognized tax benefit was recorded as a $29.7 million reduction to our gross deferred tax assets and a $282.7 million gross tax liability.

As of December 31, 2022, we have classified $44.1 million and $415.5 million of our unrecognized tax benefits as credits to “Deferred tax assets” and “Other long-term liabilities,” respectively, on our consolidated balance sheet.

Included in our unrecognized tax benefits as of December 31, 2022, 2021 and 2020, we had $208.5 million, $129.5 million and $75.8 million (net of the federal benefit on state issues), respectively, of unrecognized tax benefits, which would affect our effective income tax rate if recognized.

We recognize potential interest and penalties related to unrecognized tax benefits in our provision for income taxes. In 2022, we recognized total interest and penalty expenses of $36.6 million. As of December 31, 2022, our accrual for interest and penalties was $39.2 million. Our total interest and penalty expenses in 2021 and 2020 and our accrual for interest and penalties as of December 31, 2021 were not material to our consolidated financial statements.

The U.S. Internal Revenue Service and other local and foreign tax authorities routinely examine our tax returns, including intercompany transfer pricing, and it is reasonably possible that we will adjust the value of our uncertain tax positions related these matters and other issues as we receive additional information from various taxing authorities, including reaching settlements with such authorities.

As a result of various audit closures, settlements and statutes of limitations, we estimate that it is reasonably possible that our gross unrecognized tax benefits could decrease by up to $9.1 million in the next 12 months due to statute of limitations expirations.

We file U.S. federal income tax returns and income tax returns in various state, local and foreign jurisdictions. We have various income tax audits ongoing at any time throughout the world. Except for jurisdictions where we have NOLs or tax credit carryforwards, we are no longer subject to any tax assessment from tax authorities for years prior to 2014 in jurisdictions that have a material impact on our consolidated financial statements.

Q. Commitments and Contingencies

2022 Revolving Credit Facility

In July 2022, Vertex and certain of its subsidiaries entered into a $500.0 million unsecured revolving facility (the “Credit Agreement”) with Bank of America, N.A., as administrative agent and the lenders referred to therein (the “Lenders”), which matures on July 1, 2027. The Credit Agreement was not drawn upon at closing and we have not drawn upon it to date. Amounts drawn pursuant to the Credit Agreement, if any, will be used for general corporate purposes. Subject to satisfaction

of certain conditions, we may request that the borrowing capacity for the Credit Agreement be increased by an additional $500.0 million. Additionally, the Credit Agreement provides a sublimit of $100.0 million for letters of credit.

Any amounts borrowed under the Credit Agreement will bear interest, at our option, at either a base rate or a Secured Overnight Financing Rate ("SOFR"), in each case plus an applicable margin. Under the Credit Agreement, the applicable margins on base rate loans range from 0.000% to 0.500% and the applicable margins on SOFR loans range from 1.000% to 1.500%, in each case based on our consolidated leverage ratio (the ratio of our total consolidated funded indebtedness to our consolidated EBITDA for the most recently completed four fiscal quarter period).

Any amounts borrowed pursuant to the Credit Agreement are guaranteed by certain of our existing and future domestic subsidiaries, subject to certain exceptions.

The Credit Agreement contains customary representations and warranties and affirmative and negative covenants, including a financial covenant to maintain subject to certain limited exceptions, a consolidated leverage ratio of 3.50 to 1.00, subject to an increase to 4.00 to 1.00 following a material acquisition. As of December 31, 2022, we were in compliance with the covenants described above. The Credit Agreement also contains customary events of default. In the case of a continuing event of default, the administrative agent would be entitled to exercise various remedies, including the acceleration of amounts due under outstanding loans.

Direct costs related to the Credit Agreement are recorded over its term and were not material to our financial statements.

Prior Credit Facilities

In July 2022, in conjunction with entering our new credit agreement, we terminated the $500.0 million credit agreement we entered into in 2019. In September 2022, a $2.0 billion credit agreement we entered into in 2020 expired in accordance with its terms.

Guaranties and Indemnifications

As permitted under Massachusetts law, our Articles of Organization and By-laws provide that we will indemnify certain of our officers and directors for certain claims asserted against them in connection with their service as an officer or director. The maximum potential amount of future payments that we could be required to make under these indemnification provisions is unlimited. However, we have purchased directors' and officers' liability insurance policies that could reduce our monetary exposure and enable us to recover a portion of any future amounts paid. No indemnification claims currently are outstanding, and we believe the estimated fair value of these indemnification arrangements is minimal.

We customarily agree in the ordinary course of our business to indemnification provisions in agreements with clinical trial investigators and sites in our product development programs, sponsored research agreements with academic and not-for-profit institutions, various comparable agreements involving parties performing services for us, and our real estate leases. We also customarily agree to certain indemnification provisions in our drug discovery, development and commercialization collaboration agreements. With respect to our clinical trials and sponsored research agreements, these indemnification provisions typically apply to any claim asserted against the investigator or the investigator's institution relating to personal injury or property damage, violations of law or certain breaches of our contractual obligations arising out of the research or clinical testing of our compounds or product candidates. With respect to lease agreements, the indemnification provisions typically apply to claims asserted against the landlord relating to personal injury or property damage caused by us, to violations of law by us or to certain breaches of our contractual obligations. The indemnification provisions appearing in our collaboration agreements are similar to those for the other agreements discussed above, but in addition provide some limited indemnification for our collaborator in the event of third-party claims alleging infringement of intellectual property rights. In each of the cases above, the indemnification obligation generally survives the termination of the agreement for some extended period, although we believe the obligation typically has the most relevance during the contract term and for a short period of time thereafter. The maximum potential amount of future payments that we could be required to make under these provisions is generally unlimited. We have purchased insurance policies covering personal injury, property damage and general liability that reduce our exposure for indemnification and would enable us in many cases to recover all or a portion of any future amounts paid. We have never paid any material amounts to defend lawsuits or settle claims related to these indemnification provisions. Accordingly, we believe the estimated fair value of these indemnification arrangements is

minimal.

Other Contingencies

We have certain contingent liabilities that arise in the ordinary course of our business activities. We accrue such contingent liabilities when it is probable that future expenditures will be made and such expenditures can be reasonably estimated. Other than our contingent consideration liabilities discussed in Note E, "Fair Value Measurements," there were no material contingent liabilities accrued as of December 31, 2022 or 2021.

R. Segment Information

Segment reporting is prepared on the same basis that our chief executive officer, who is our chief operating decision maker, manages the business, makes operating decisions and assesses performance. We operate in one segment, pharmaceuticals. Enterprise-wide disclosures about revenues, significant customers, and property and equipment, net by location are presented below.

Revenues by Product

Product revenues, net consisted of the following:

	2022	2021	2020
		(in millions)	
TRIKAFTA/KAFTRIO	$ 7,686.8	$ 5,697.2	$ 3,863.8
SYMDEKO/SYMKEVI	180.0	420.4	628.6
ORKAMBI	510.7	771.6	907.5
KALYDECO	553.2	684.2	802.9
Total product revenues, net	$ 8,930.7	$ 7,573.4	$ 6,202.8

Product Revenues by Geographic Location

Net product revenues are attributed to countries based on the location of the customer and consisted of the following:

	2022	2021	2020
		(in millions)	
United States	$ 5,699.3	$ 5,287.3	$ 4,826.4
Outside of the United States			
Europe	2,705.5	1,972.9	1,126.5
Other	525.9	313.2	249.9
Total product revenues outside of the United States	3,231.4	2,286.1	1,376.4
Total product revenues, net	$ 8,930.7	$ 7,573.4	$ 6,202.8

Significant Customers

Gross product revenues and accounts receivable from each of our customers who individually accounted for 10% or more of total gross product revenues and/or 10% or more of total accounts receivable consisted of the following:

	Percent of Total Gross Product Revenues			Percent of Accounts Receivable	
	Year Ended December 31,			As of December 31,	
	2022	2021	2020	2022	2021
McKesson Corporation	25 %	22 %	20 %	22 %	21 %
Accredo Health Group, Inc.	12 %	12 %	15 %	<10%	10 %
Walgreen Co.	10 %	10 %	14 %	<10%	<10 %
Lloyds Pharmacy*	<10%	<10%	<10%	12 %	15 %

*A wholly-owned subsidiary of McKesson Corporation in the U.K. until 2022.

Long-lived Assets by Location

Long-lived assets by location consisted of the following:

	As of December 31,	
	2022	2021
	(in millions)	
United States	$ 1,365.5	$ 1,348.1
Outside of the United States		
United Kingdom	75.7	60.9
Other	14.6	15.4
Total long-lived assets outside of the United States	90.3	76.3
Total long-lived assets	$ 1,455.8	$ 1,424.4

AMENDED AND RESTATED

BY-LAWS

of

VERTEX PHARMACEUTICALS INCORPORATED

Effective as of February 8, 2023

ARTICLE I

SHAREHOLDERS

Section 1. Annual Meeting. The annual meeting of the shareholders shall be held on such date within six months after the end of the fiscal year of Vertex Pharmaceuticals Incorporated (the "Corporation") as the Board of Directors of the Corporation (the "Board of Directors") shall fix, at such time as shall be fixed by the Board of Directors in the call of the meeting. Purposes for which an annual meeting is to be held, in addition to those prescribed by law, by the Articles of Organization, or by these By-Laws, may be specified by the Board of Directors in the notice of the meeting.

Section 2. Special Meeting in Lieu of Annual Meeting. If no annual meeting has been held in accordance with the foregoing provisions, a special meeting of the shareholders may be held in lieu thereof. Any action taken at such special meeting shall have the same force and effect as if taken at the annual meeting, and in such case all references in these By-Laws to the annual meeting of the shareholders shall be deemed to refer to such special meeting. Any such special meeting shall be called as provided in Section 3 of this Article 1.

Section 3. Special Meetings. A special meeting of the shareholders may be called at any time by the Chair of the Board, the President, or by the Board of Directors. A special meeting of the shareholders shall also be called by the Secretary (or, in the case of the death, absence, incapacity, or refusal of the Secretary, by any other officer) upon written application of one or more shareholders who hold at least forty percent in interest of the capital stock entitled to vote at the meeting. Each call of a meeting shall state the place, date, hour, and purposes of the meeting.

Section 4. Place of the Meetings. All meetings of the shareholders shall be held at such place, either within or without The Commonwealth of Massachusetts, within the United States as shall be fixed by the Board of Directors in the notice of the meeting; provided that the meeting may be held without a physical place to the extent permitted by law. Any adjourned session of any meeting of the shareholders shall be held at such place designated by the shareholders in the vote of adjournment.

Section 5. Notice of Meeting. A written notice of each meeting of shareholders, stating the place, date, hour and purposes of the meeting, shall be given at least seven days before the meeting to each shareholder entitled to vote thereat and to each shareholders who, by law, by the Articles of Organization, or by these By-Laws, is entitled to notice. Such notice shall be given by the Secretary or an Assistant Secretary or by an officer designated by the Board of Directors. Whenever notice of a meeting is required to be given to a shareholder under any provision of the Business Corporation Law of the Commonwealth of Massachusetts or of the Articles of Organization or these By-Laws, a written waiver thereof, executed before or after the meeting by such shareholder or such shareholder's attorney thereunto authorized and filed with the records of the meeting, shall be deemed equivalent to such notice.

Section 6. Quorum of Shareholders. At any meeting of the shareholders, a quorum shall consist of a majority in interest of all stock issued and outstanding and entitled to vote at the meeting, except when a larger quorum is required by law, by the Articles of Organization, or by these By-Laws. Stock owned directly or indirectly by the Corporation, if any, shall not be deemed outstanding for this purpose.

Section 7. Adjournment of Meetings. Any meeting of the shareholders may be adjourned (a) prior to the time the meeting has been convened, by the Board of Directors, or (b) after the meeting has been convened, by a majority of the votes properly cast upon the question, whether or not a quorum is present at the meeting, and the meeting may be held as adjourned without further notice.

Section 8. Action by Vote. When a quorum is present at any meeting, (a) upon any question other than an election of a director, a majority of the votes properly cast shall decide the question, except when a larger vote is required by law, by the Articles of Organization, or by these By-Laws, (b) in an uncontested election, votes properly cast in favor of election of a director exceeding the votes properly withheld in such election shall effect the election of a director, and (c) in a contested election, a plurality of the votes properly cast for election shall effect the election of a director. An election of directors shall be considered contested if, as of the record date for the applicable meeting, there are more nominees for election than positions on the Board of Directors to be filled by election at the meeting. All other elections of directors shall be considered uncontested.

Section 9. Voting. Shareholders entitled to vote shall have one vote for each share of stock held by them of record according to the records of the Corporation, unless otherwise provided by the Articles of Organization. The Corporation shall not, directly or indirectly, vote any share of its own stock.

Section 10. Proxies. To the extent permitted by law, shareholders entitled to vote may vote either in person or by written proxy. Unless otherwise specified or limited by their terms, such proxies shall entitle the holders thereof to vote at any adjournment of such meeting but shall not be valid after the final adjournment of such meeting. Any

shareholder directly or indirectly soliciting proxies from other shareholders must use a proxy card color other than white, which shall be reserved for exclusive use by the Corporation.

Section 11. Action by Consent. Any action required or permitted to be taken at any meeting of the shareholders may be taken without a meeting, but only if all shareholders entitled to vote on the matter consent to the action in writing and the written consents are filed with the records of meetings of shareholders. Such consents shall be treated for all purposes as a vote taken at a meeting.

Section 12. Order of Business.

(a) Annual Meeting. At any annual meeting of the shareholders, only such nominations for the election of directors shall be made, and only such other business shall be conducted or considered, as shall have been properly brought before the meeting. For nominations to be properly made at an annual meeting, and for other business to be properly brought before an annual meeting, such nominations and other business must be (i) specified in the notice of meeting (or any supplement thereto) given by or at the direction of the Board of Directors in accordance with Section 5 of this Article I, (ii) otherwise made at the annual meeting by or at the direction of the Board of Directors or (iii) otherwise properly requested to be brought before the annual meeting by a shareholder of the Corporation in accordance with Section 13 of this Article I or Section 8 of Article II. For nominations for the election of directors or other business to be properly requested by a shareholder to be made at or brought before an annual meeting pursuant to this Section 12: (A) the nominating shareholder must be a shareholder of record at the time of giving of notice of such annual meeting by or at the direction of the Board of Directors, on the record date for determination of shareholders entitled to vote at such meeting, and at the time of the annual meeting; (B) the nominating shareholder must be entitled to vote in the election of directors generally at such annual meeting; (C) the nominating shareholder must comply with the procedures set forth in these By-Laws as to such nomination or other business; and (D) in the case of nominations, such nomination must comply in all respects with the requirements of Section 14 of the Securities Exchange Act of 1934, as amended (the "Exchange Act"), including, without limitation, the requirements of Rule 14a-19 (as such rules and regulations may be amended from time to time by the Securities and Exchange Commission, including any Securities and Exchange Commission staff interpretations relating thereto). Clause (iii) of this Section 12(a) shall be the exclusive means for a shareholder to make nominations or bring other business (other than matters properly brought under Rule 14a-8 under the Exchange Act and included in the Corporation's notice of meeting) before an annual meeting of shareholders.

(b) Special Meetings. Nominations for the election of directors may be made at a special meeting of shareholders at which directors are to be elected pursuant to the Corporation's notice of meeting: (i) by or at the direction of the Board of Directors; or (ii) by any shareholder of the Corporation who: (A) is a shareholder of record at the time of giving of notice of such special meeting, on the record date for determination of shareholders entitled to vote at such meeting, and at the time of the special meeting; (B) is entitled to vote in the election of

directors generally at such meeting; and (C) complies with the procedures set forth in these By-Laws as to such nomination. At any special meeting of the shareholders, only such nominations for the election of directors shall be made, and only such other business shall be conducted or considered, as shall have been properly brought before the meeting. For nominations to be properly made at a special meeting, and for other business to be properly brought before a special meeting, such nominations and other business must be: (1) specified in the Corporation's notice of meeting (or any supplement thereto) given by or at the direction of the Board of Directors in accordance with Section 5 of this Article ; (2) otherwise brought before the special meeting by or at the direction of the Board of Directors; or (3) otherwise properly requested to be brought before the special meeting by a shareholder of the Corporation in accordance with Section 13 of this Article I; provided, however, that nothing herein shall prohibit the Board of Directors from submitting additional matters to shareholders at any such special meeting. This Section 12(b)(ii) shall be the exclusive means for a shareholder to make nominations or to bring other business (other than matters properly brought under Rule 14a-8 under the Exchange Act and included in the Corporation's notice of meeting) before a special meeting of shareholders.

(c) General. Except as otherwise provided by law, by the Articles of Organization or by these By-Laws, the presiding officer of any annual or special meeting shall have the power to determine whether a nomination or any other business proposed to be brought before the meeting was made or proposed, as the case may be, in accordance with these By-Laws and, if any proposed nomination or other business is not in compliance with these By-Laws, to declare that no action shall be taken on such nomination or other business and such nomination or other business shall be disregarded.

Section 13. Advance Notice of Shareholder Business and Nominations.

(a) Annual and Special Meetings. Without qualification or limitation, for any nominations or any other business to be properly brought before an annual meeting or special meeting by a shareholder pursuant to Section 12 of this Article I, the shareholder must have given timely notice thereof in writing to the Secretary in proper form, and in accordance with this Section 13 or Section 8 of Article II.

To be timely, a shareholder's notice must be given, either by personal delivery or by mailing it, postage prepaid, to the Secretary (a) with respect to an annual meeting of shareholders, not earlier than one hundred twenty (120) days prior to the anniversary date of the immediately preceding annual meeting and not later than ninety (90) days prior to the anniversary date of the immediately preceding annual meeting, and (b) with respect to a special meeting of shareholders, not later than the close of business on the tenth day following the date on which notice of such meeting is first given to shareholders. In no event shall any adjournment, recess, rescheduling or postponement of an annual meeting or special meeting commence a new time period for the giving of a shareholder's notice as described above. A shareholder shall not be entitled to make additional or substitute nominations following the expiration of the time periods set forth in these By-Laws.

(b) Disclosure Requirements. Without qualification or limitation, for any nominations or any other business to be properly brought before an annual meeting or special meeting by a shareholder pursuant to Section 12 of this Article I, the shareholder must have given timely notice thereof in writing to the Secretary in proper form, and in accordance with this Section 13 or Section 8 of Article II, as applicable.

To be in proper form, each such notice shall set forth the following, as applicable:

(i) As to the shareholder giving the notice and the beneficial owner, if any, on whose behalf the nomination is made or business is brought, as applicable, a shareholder's notice must set forth: (A) the name and address of such shareholder, as they appear on the Corporation's books, of such beneficial owner, if any, and any persons that are acting in concert therewith; (B) a representation that the shareholder giving notice is a holder of record of stock of the Corporation entitled to vote at such meeting and intends to appear in person or by proxy at the meeting to nominate the person or persons specified in the notice; (C) (1) the class or series and number of shares of the Corporation which are, directly or indirectly, owned beneficially and of record by such shareholder, such beneficial owner and their respective affiliates or associates, or others acting in concert therewith; (2) any option, warrant, convertible security, stock appreciation right, or similar right with an exercise or conversion privilege or a settlement payment or mechanism at a price related to any security of the Corporation or with a value derived, in whole or in part, from the value of any security of the Corporation, or any derivative or synthetic arrangement having the characteristics of a long position in any security of the Corporation, or any contract, derivative, swap or other transaction or series of transactions designed to produce economic benefits and risks that correspond substantially to the ownership of any security of the Corporation, including due to the fact that the value of such contract, derivative, swap or other transaction or series of transactions is determined by reference to the price, value or volatility of any security of the Corporation, whether or not such instrument, contract or right shall be subject to settlement in the underlying securities of the Corporation, through the delivery of cash or other property, or otherwise, and without regard to whether the shareholder of record, the beneficial owner, if any, or any of their respective affiliates or associates, or others acting in concert therewith, may have entered into transactions that hedge or mitigate the economic effect of such instrument, contract or right, or any other direct or indirect opportunity to profit or share in any profit derived from any increase or decrease in the value of securities of the Corporation (any of the foregoing, a "Derivative Instrument") directly or indirectly owned beneficially by such shareholder, the beneficial owner, if any, or any of their respective affiliates or associates, or others acting in concert therewith; (3) any proxy, contract, arrangement, understanding, or relationship pursuant to which such shareholder, such beneficial owner or any of their respective affiliates or associates, or others acting in concert therewith has any right to vote any security of the Corporation; (4) any agreement, arrangement, understanding, relationship or otherwise, including any repurchase or similar so-called "stock borrowing" agreement or arrangement, involving such shareholder, such beneficial owner or any of their respective

affiliates or associates, or others acting in concert therewith, directly or indirectly, the intent, purpose or effect of which may be to mitigate loss to, transfer to or from any such person, in whole or in part, any of the economic consequences of ownership, or reduce the economic risk (of ownership or otherwise) of any security of the Corporation by, manage the risk of share price changes for, or increase or decrease the voting power of, such shareholder, such beneficial owner or any of their respective affiliates or associates, or others acting in concert therewith, with respect to any security of the Corporation, or which provides, directly or indirectly, the opportunity to profit or share in any profit derived from any decrease in the price or value of any securities of the Corporation (any of the foregoing, a "Short Interest"); (5) any rights to dividends on the shares of the Corporation owned beneficially by such shareholder, such beneficial owner or any of their respective affiliates or associates, or others acting in concert therewith, that are separated or separable from the underlying shares of the Corporation; (6) any proportionate interest in securities of the Corporation or Derivative Instruments held, directly or indirectly, by a general or limited partnership or similar entity in which such shareholder, such beneficial owner or any of their respective affiliates or associates, or others acting in concert therewith, is a general partner or, directly or indirectly, beneficially owns an interest in a general partner or is the manager or managing member or, directly or indirectly, beneficially owns any interest in the manager or managing member of such general or limited partnership or similar entity; (7) any performance-related fees (other than an asset-based fee) that such shareholder, such beneficial owner or any of their respective affiliates or associates, or others acting in concert therewith, is entitled to based on any increase or decrease in the value of securities of the Corporation or Derivative Instruments or Short Interests, if any; (8) any direct or indirect interest, including significant equity interests or any Derivative Instruments or Short Interests in any principal competitor of the Corporation held by such shareholder, such beneficial owner or any of their respective affiliates or associates, or others acting in concert therewith; and (9) any direct or indirect interest of such shareholder, such beneficial owner and their respective affiliates or associates, or others acting in concert therewith, in any contract with, or any litigation involving, the Corporation, any affiliate of the Corporation or any principal competitor of the Corporation (including, in any such case, any employment agreement, collective bargaining agreement or consulting agreement) (sub-clauses (1) through (9) above of this Section 13(b)(i) shall be referred, collectively, as the "Ownership Information"); (D) in the case of a notice of nomination delivered pursuant to Section 12(a), a representation that such nominating shareholder or beneficial owner, if any, intends to solicit the holders of shares representing at least 67% of the voting power of shares entitled to vote on the election of directors in support of director nominees other than the Corporation's nominees in accordance with Rule 14a-19 under the Exchange Act; (E) a certification that each such shareholder, such beneficial owner or any of their respective affiliates or associates, or others acting in concert therewith, has complied with all applicable federal, state and other legal requirements in connection with its acquisition of shares or other securities of the Corporation and such person's acts or omissions as a shareholder of the Corporation; (F) the names and addresses of other shareholders (including beneficial owners) known by any such shareholder, such beneficial owner or any of their respective affiliates or associates, or others acting in

concert therewith, to financially or otherwise materially support (it being understood, for example, that statement of an intent to vote for, or delivery of a revocable proxy to such proponent, does not require disclosure under this Section 13(b), but solicitation of other shareholders by such supporting shareholder would require disclosure under this Section 13(b)) such nomination(s) or proposal(s), and to the extent known the class and number of all shares of the Corporation's capital stock owned beneficially or of record by such other shareholder(s) or other beneficial owner(s); (G) all information that would be required to be set forth in a Schedule 13D filed pursuant to Rule 13d-1(a) or an amendment pursuant to Rule 13d-2(a) if such a statement were required to be filed under the Exchange Act and the rules and regulations promulgated thereunder by such shareholder, such beneficial owner and their respective affiliates or associates, or others acting in concert therewith, if any; and (H) any other information relating to such shareholder, such beneficial owner or any of their respective affiliates or associates or others acting in concert therewith, if any, that would be required to be disclosed in a proxy statement and form of proxy or other filings required to be made in connection with solicitations of proxies for, as applicable, the business proposal and/or for the election of directors in a contested election pursuant to Section 14 of the Exchange Act and the rules and regulations promulgated thereunder.

(ii) If the notice includes any business other than a nomination of a director or directors that the shareholder proposes to bring before the meeting, a shareholder's notice must, in addition to the matters set forth in Section 13(b)(i), also set forth: (A) a brief description of the business desired to be brought before the meeting, the reasons for conducting such business at the meeting and any material interest of such shareholder, such beneficial owner and each of their respective affiliates or associates or others acting in concert therewith, if any, in such business; (B) the text of the business proposal (including the text of any resolutions proposed for consideration and, in the event that such proposal includes a proposal to amend the By-Laws of the Corporation, the text of the proposed amendment); and (C) a description of all agreements, arrangements and understandings between such shareholder, such beneficial owner and each of their respective affiliates or associates or others acting in concert therewith, if any, on the one hand, and any other person or persons (including their names), on the other hand, in connection with the business proposal by such shareholder.

(iii) As to each individual, if any, whom the shareholder proposes to nominate for election or reelection to the Board of Directors, a shareholder's notice must, in addition to the matters set forth in Section 13(b)(i), also set forth: (i) the name, age, business and residence address of such person; (ii) the principal occupation or employment of such person (present and for the past five (5) years); (iii) the completed and signed questionnaire, representation, agreement required by Section 14 of this Article I; (iv) all information relating to such individual that would be required to be disclosed in a proxy statement or other filings required to be made in connection with solicitations of proxies for election of directors in a contested election pursuant to Section 14 of the Exchange Act and the rules and regulations

promulgated thereunder (including such individual's written consent to being named as a nominee in any proxy materials relating to the Corporation's next annual meeting or special meeting, as applicable) and a written statement of intent to serve as a director for the full term if elected; and (v) a description of all direct and indirect compensation and other material monetary agreements, arrangements and understandings during the past three (3) years, and any other material relationships, between or among such shareholder and beneficial owner, if any, and their respective affiliates and associates, or others acting in concert therewith, on the one hand, and each proposed nominee, and his or her respective affiliates and associates, or others acting in concert therewith, on the other hand, including, without limitation, all biographical and related party transaction and other information that would be required to be disclosed pursuant to Rule 404 promulgated under Regulation S-K if the shareholder making the nomination and any beneficial owner on whose behalf the nomination is made, if any, or any affiliate or associate thereof or person acting in concert therewith, were the "registrant" for purposes of such rule and the nominee were a director or executive officer of such registrant.

(iv) In addition, to be considered timely, a shareholder's notice shall further be updated and supplemented, if necessary, so that the information provided or required to be provided in such notice shall be true and correct as of the record date for determining the shareholders of record entitled to notice of the meeting (or any adjournment, recess, rescheduling or postponement thereof) and as of the date that is ten (10) days prior to the meeting (or any adjournment, recess, rescheduling or postponement thereof), and such update and supplement shall be delivered to the Secretary not later than ten (10) days after the record date for determining the shareholders of record entitled to notice of the meeting (or any adjournment, recess, rescheduling or postponement thereof). The obligation to update and supplement as set forth in this paragraph or any other Section of these By-Laws shall not limit the Corporation's rights with respect to any deficiencies in any notice provided by a shareholder, extend any applicable deadlines hereunder or under any other provision of these By-Laws or enable or be deemed to permit a shareholder who has previously submitted notice hereunder or under any other provision of these By-Laws to amend or update any nomination or business proposal or to submit any new nomination or business proposal, including by changing or adding nominees, matters, business and or resolutions proposed to be brought before a meeting of the shareholders.

(v) The Corporation may also, as a condition to any such nomination or business being deemed properly brought before an annual or special meeting, require any shareholder giving the notice and the beneficial owner, if any, on whose behalf the nomination or business proposal, as applicable, is made, or any proposed nominee to deliver to the Secretary, within five (5) business days of any such request, such other information as may reasonably be required by the Corporation or its Board of Directors, in its sole discretion, to determine (A) the eligibility of such proposed nominee to serve as a director of the Corporation, (B) whether such nominee qualifies as an "independent director" or "audit

committee financial expert" under applicable law, securities exchange rule or regulation, or any publicly disclosed corporate governance guideline or committee charter of the Corporation or (C) such other information that the Board of Directors determines, in its sole discretion, could be material to a reasonable shareholder's understanding of the independence, or lack thereof, of such nominee. Notwithstanding anything to the contrary, only persons who are nominated in accordance with the procedures set forth in these By-Laws, including, without limitation, Section 12, Section 13, Section 14 and Section 8 of Article II, shall be eligible for election as directors; and

(vi) Notwithstanding anything to the contrary in this Section 13, to the extent the shareholder of record giving the notice is acting solely at the direction of the beneficial owner and not also on its own behalf or in concert with a beneficial owner, and is not an affiliate or associate or such beneficial owner, information otherwise required by clauses (A), (B), (C) and (D) of Section 13(b)(i) shall not be required of or with respect to such shareholder of record.

Nothing in these By-Laws shall be deemed to affect any rights: (a) of shareholders to request inclusion of business proposals in the Corporation's proxy statement pursuant to Rule 14a-8 under the Exchange Act; or (b) of the holders of any series of Preferred Stock if and to the extent provided for under law, the Articles of Organization or these By-Laws. Subject to Rules 14a-8 and 14a-19 under the Exchange Act and Section 8 of Article II, nothing in these By-Laws shall be construed to permit any shareholder, or give any shareholder the right, to include or have disseminated or described in the Corporation's proxy statement any nomination of director or directors or any other business proposal.

(c) A shareholder who has delivered a notice of nomination pursuant to Section 12(a) shall promptly certify to the Corporation in writing that it has complied with the requirements of Rule 14a-19 under the Exchange Act and deliver no later than five (5) business days prior to the meeting, reasonable evidence that it has complied with such requirements.

(d) Notwithstanding anything to the contrary herein, unless otherwise required by law, if any shareholder (i) provides notice pursuant to Rule 14a-19 under the Exchange Act and (ii) subsequently (A) notifies the Corporation that such shareholder no longer intends to solicit proxies in support of director nominees other than the Corporation's director nominees in accordance with Rule 14a-19, (B) fails to comply with the requirements of Rule 14a-19, or (C) fails to provide reasonable evidence sufficient to satisfy the Corporation that such requirements have been met, such shareholder's nomination(s) shall be deemed null and void and the Corporation shall disregard any proxies or votes solicited for any nominee proposed by such shareholder.

Section 14. Submission of Questionnaire, Representation and Agreement. To be eligible to be a nominee for election or reelection as a director of the Corporation, a person must deliver (in accordance with the time periods

prescribed for delivery of notice under Section 13 of this Article I or Section 8 of Article II, as applicable) to the Secretary a written questionnaire with respect to the background and qualification of such individual and the background of any other person or entity on whose behalf, directly or indirectly, the nomination is being made, and a written representation and agreement (in the form provided by the Secretary, which form shall be provided by the Secretary upon written request of any shareholder of record; provided that, such written request identifies both the shareholder of record making such request and the beneficial owner(s), if any, on whose behalf such request is being made) that such individual: (a) is not and will not become a party to (i) any agreement, arrangement or understanding with, and has not given any commitment or assurance to, any person or entity as to how such Shareholder Nominee, if elected as a director of the Corporation, will act or vote on any issue or question (a "Voting Commitment") that has not been disclosed to the Corporation in such representation and agreement or (ii) any Voting Commitment that could limit or interfere with such person's ability to comply, if elected as a director of the Corporation, with such person's fiduciary duties under applicable law, (b) is not and will not become a party to any agreement, arrangement or understanding with any person or entity other than the Corporation with respect to any direct or indirect compensation, reimbursement or indemnification in connection with such person's nomination or service or action as a director that has not been disclosed to the Corporation in such representation and agreement, (c) would be in compliance, if elected as a director of the Corporation, and will comply with the Corporation's code of conduct, corporate governance guidelines, stock ownership and trading policies and guidelines and any other policies or guidelines of the Corporation applicable to directors and (d) will make such other acknowledgments, enter into such agreements and provide such information as the Board of Directors requires of all directors, including promptly submitting all completed and signed questionnaires required of the Corporation's directors.

ARTICLE II

BOARD OF DIRECTORS

Section 1. Number and Elections. Subject to the rights of the holders of Preferred Stock to elect one or more additional directors under specified circumstances as provided in Article 4 of the Articles of Organization, the Board of Directors shall consist of not less than three (3) nor more than eleven (11) persons, the exact number to be fixed from time to time by the Board of Directors pursuant to a resolution adopted by a majority vote of the directors then in office. The directors shall be elected in the manner provided in the Articles of Organization and these By-Laws.

Section 2. Chair of the Board. The Chair of the Board shall be chosen from among the directors and may or may not be the Chief Executive Officer and/or President. The Chair of the Board shall preside at all meetings of the Board of Directors and shall have the duties and powers specified in these By-Laws and such other duties and powers as may be determined by the Board of Directors.

Section 3. Newly Created Directorships and Vacancies. Newly created directorships and vacancies on the Board of Directors shall be filled as provided in the Articles of Organization.

Section 4. Removal of Directors. Directors may be removed from office only as provided in the Articles of Organization.

Section 5. Directors Elected by Holders of Preferred Stock. Whenever the holders of any class or series or Preferred Stock or of any other class or series of shares issued by the Corporation shall have the right, voting separately as a class or series, to elect one or more directors under specified circumstances, the election, term of office, filling of vacancies, and other features of such directorships shall be governed by the terms of the Articles of Organization applicable thereto, and none of the provisions of Sections 1 to 4 of this Article II shall apply with respect to directors so elected.

Section 6. Resignations. Any director, member of a committee, or officer may resign at any time by delivering a resignation in writing to the Chair of the Board, the President, the Secretary, or to a meeting of the Board of Directors. Such resignation shall be effective upon receipt unless specified to be effective at some other time.

Section 7. Powers. Except as reserved to the shareholders by law, by the Articles of Organization, or by these By-Laws, the business of the Corporation shall be managed by the Board of Directors who shall have and may exercise all the powers of the Corporation.

Section 8. Proxy Access for Director Nominations.

(a) Information to be Included in the Corporation's Proxy Materials. Whenever the Board of Directors solicits proxies with respect to the election of directors at an annual meeting of shareholders, subject to the provisions of this Section 8, the Corporation shall include in its proxy statement for such annual meeting, in addition to any persons nominated for election by the Board of Directors or a committee appointed by the Board of Directors, the name, together with the Required Information (as defined below), of any person to be nominated for election to the Board of Directors by a shareholder pursuant to Section 12 and Section 13 of Article I (a "Shareholder Nominee") if (i) the shareholder of record who intends to make the nomination qualifies as, or is acting on behalf of, an Eligible Shareholder (as defined in Section 8(c) of this Article II), (ii) the Eligible Shareholder expressly elects, in a written statement accompanying the notice required by Section 12 and Section 13 of Article I (a "Nomination Notice"), to have its Shareholder Nominee included in the Corporation's proxy materials pursuant to this Section 8 and (iii) all of the other requirements set forth in this Section 8 and in Section 12 and Section 13 of Article I are satisfied. For purposes of this Section 8, the "Required Information" that the Corporation will include in its proxy statement is (A) the information provided to the Secretary concerning the

Shareholder Nominee and the Eligible Shareholder that is required to be disclosed in the Corporation's proxy statement pursuant to Section 14 of the Exchange Act, and the rules and regulations promulgated thereunder, and (B) if the Eligible Shareholder so elects, a Supporting Statement (as defined in Section 8(g) of this Article II). Nothing in this Section 8 shall limit the Corporation's ability to solicit against any Shareholder Nominee or include in its proxy materials the Corporation's own statements or other information relating to any Eligible Shareholder or Shareholder Nominee, including any information provided to the Corporation pursuant to this Section 8. Subject to the provisions of this Section 8, the name of any Shareholder Nominee included in the Corporation's proxy statement for an annual meeting of shareholders shall also be set forth on the form of proxy distributed by the Corporation in connection with such annual meeting.

(b) Permitted Number of Shareholder Nominees. The maximum number of Shareholder Nominees that will be included in the Corporation's proxy materials with respect to an annual meeting of shareholders shall not exceed the greater of (i) two or (ii) 20% of the number of directors in office as of the last day on which a Nomination Notice may be delivered pursuant to Section 13 of Article I (the "Final Proxy Access Date") or, if such amount is not a whole number, the closest whole number below 20% (such greater number, as it may be adjusted pursuant to this Section 8(b)), the "Permitted Number"). In the event that one or more vacancies for any reason occurs on the Board of Directors after the Final Proxy Access Date but before the date of the annual meeting and the Board of Directors resolves to reduce the size of the Board of Directors in connection therewith, the Permitted Number shall be calculated based on the number of directors in office as so reduced. In addition, the Permitted Number shall be reduced by (i) the number of individuals who will be included in the Corporation's proxy materials as nominees recommended by the Board of Directors pursuant to an agreement, arrangement or other understanding with a shareholder or group of shareholders (other than any such agreement, arrangement or understanding entered into in connection with an acquisition of stock from the Corporation by such shareholder or group of shareholders), together with the number of directors in office as of the Final Proxy Access Date who were either elected by the Board of Directors to fill a vacancy pursuant to such an agreement, arrangement or other understanding, or included in the Corporation's proxy materials as nominees recommended by the Board of Directors pursuant to such an agreement, arrangement or other understanding for any of the two preceding annual meetings of shareholders, and whose remaining terms extend beyond the upcoming annual meeting, and (ii) the number of directors in office as of the Final Proxy Access Date who were included in the Corporation's proxy materials as Shareholder Nominees for any of the two preceding annual meetings of shareholders (including any persons counted as Shareholder Nominees pursuant to the immediately succeeding sentence) and whose remaining terms extend beyond the upcoming annual meeting. For purposes of determining when the Permitted Number has been reached, any individual requested by an Eligible Shareholder to be included in the Corporation's proxy materials pursuant to this Section 8 whose nomination is subsequently withdrawn or whom the Board of Directors decides to nominate for election to the Board of Directors shall be counted as one of the Shareholder Nominees. Any Eligible Shareholder requesting that more than one Shareholder Nominee be included in the Corporation's proxy materials pursuant to this Section 8 shall rank such Shareholder Nominees based on the order in which the Eligible Shareholder desires such

Shareholder Nominees to be selected for inclusion in the Corporation's proxy materials in the event that the total number of Shareholder Nominees requested by Eligible Shareholders to be included in the Corporation's proxy materials pursuant to this Section 8 exceeds the Permitted Number. In the event that the number of Shareholder Nominees requested by Eligible Shareholders to be included in the Corporation's proxy materials pursuant to this Section 8 exceeds the Permitted Number, the highest ranking Shareholder Nominee who meets the requirements of this Section 8 from each Eligible Shareholder will be selected for inclusion in the Corporation's proxy materials until the Permitted Number is reached, going in order of the amount (largest to smallest) of shares of stock of the Corporation each Eligible Shareholder disclosed as owned in its Nomination Notice. If the Permitted Number is not reached after the highest ranking Shareholder Nominee who meets the requirements of this Section 8 from each Eligible Shareholder has been selected, then the next highest ranking Shareholder Nominee who meets the requirements of this Section 8 from each Eligible Shareholder will be selected for inclusion in the Corporation's proxy materials, and this process will continue as many times as necessary, following the same order each time, until the Permitted Number is reached. Notwithstanding anything to the contrary contained in this Section 8, the Corporation shall not be required to include any Shareholder Nominees in its proxy materials pursuant to this Section 8 for any meeting of shareholders for which the Corporation receives a Nomination Notice (whether or not subsequently withdrawn) and the shareholder by whom or on whose behalf the nomination is to be made does not expressly elect, in a written statement accompanying the Nomination Notice, to have its Shareholder Nominee included in the Corporation's proxy materials pursuant to this Section 8.

(c) Eligible Shareholder. An "Eligible Shareholder" is a shareholder or a group of no more than 20 shareholders (counting as one shareholder, for this purpose, any two or more funds that are part of the same Qualifying Fund Group (as defined below)) that (i) has Owned (as defined in Section 8(d) of this Article II) continuously for at least three years (the "Minimum Holding Period") a number of shares of stock of the Corporation that represents at least three percent of the voting power of the outstanding shares of stock as of the date the Nomination Notice is delivered to or mailed and received by the Secretary of the Corporation in accordance with Section 13 of Article I (the "Required Shares") and (ii) continues to Own the Required Shares through the date of the annual meeting. A "Qualifying Fund Group" is any two or more funds that are (A) under common management and investment control, (B) under common management and funded primarily by the same employer or (C) a "group of investment companies" as such term is defined in Section 12(d)(1)(G)(ii) of the Investment Company Act of 1940, as amended. Whenever the Eligible Shareholder consists of a group of shareholders (including a group of funds that are part of the same Qualifying Fund Group), (1) each provision in this Section 8 that requires the Eligible Shareholder to provide any written statements, representations, undertakings, agreements or other instruments or to meet any other conditions shall be deemed to require each shareholder (including each individual fund within a Qualifying Fund Group) that is a member of such group to provide such statements, representations, undertakings, agreements or other instruments and to meet such other conditions (except that the members of such group may aggregate the shares that each member has Owned continuously for the Minimum Holding Period in order to meet the three percent Ownership requirement of the "Required Shares" definition) and

(2) a breach of any obligation, agreement or representation under this Section 8 by any member of such group shall be deemed a breach by the Eligible Shareholder. No person may be a member of more than one group of shareholders constituting an Eligible Shareholder with respect to any annual meeting.

(d) Definition of Ownership. For purposes of this Section 8, a shareholder shall be deemed to "Own" only those outstanding shares of stock of the Corporation as to which the shareholder possesses both (i) the full voting and investment rights pertaining to the shares and (ii) the full economic interest in (including the opportunity for profit from and risk of loss on) such shares; provided that the number of shares calculated in accordance with clauses (i) and (ii) shall not include any shares (A) sold by such shareholder or any of its affiliates in any transaction that has not been settled or closed, (B) borrowed by such shareholder or any of its affiliates for any purposes or purchased by such shareholder or any of its affiliates pursuant to an agreement to resell, or (C) subject to any option, warrant, forward contract, swap, contract of sale, or other derivative or similar instrument or agreement entered into by such shareholder or any of its affiliates, whether any such instrument or agreement is to be settled with shares or with cash based on the notional amount or value of shares of outstanding capital stock of the Corporation, in any such case which instrument or agreement has, or is intended to have, the purpose or effect of (1) reducing in any manner, to any extent or at any time in the future, such shareholder's or its affiliates' full right to vote or direct the voting of any such shares or (2) hedging, offsetting or altering to any degree any gain or loss realized or realizable from maintaining the full economic ownership of such shares by such shareholder or affiliate. For purposes of this Section 8, a beneficial owner shall be considered a "shareholder" and shall "Own" shares held in the name of a nominee or other intermediary so long as such person retains the right to instruct how the shares are voted with respect to the election of directors and possesses the full economic interest in the shares. A shareholder's Ownership of shares shall be deemed to continue during any period in which (i) the shareholder has loaned such shares, provided that the shareholder has the power to recall such loaned shares on five business days' notice and includes with its Nomination Notice an agreement that it (A) will promptly recall such loaned shares upon being notified that any of its Shareholder Nominees will be included in the Corporation's proxy materials and (B) will continue to hold such shares through the date of the annual meeting, or (ii) the shareholder has delegated any voting power by means of a proxy, power of attorney or other instrument or arrangement that is revocable at any time by the shareholder. The terms "Owned," "Owning" and other variations of the word "Own" shall have correlative meanings. Whether outstanding shares of stock of the Corporation are "Owned" for these purposes shall be determined by the Board of Directors. For purposes of this Section 8, the term "affiliate" or "affiliates" shall have the meaning ascribed thereto under the General Rules and Regulations under the Exchange Act.

(e) Information to be Included with a Nomination Notice. In addition to containing the information, representations and other documents required to be set forth in a Nomination Notice pursuant to Section 13 of Article I, in order for a Shareholder Nominee to be eligible for inclusion in the Corporation's proxy materials pursuant to this Section 8, the Nomination Notice must also set forth or be accompanied by the following:

(i) a written statement by the Eligible Shareholder setting forth and certifying as to the number of shares of stock it Owns and has Owned continuously for the Minimum Holding Period;

(ii) one or more written statements from the record holder of the Required Shares (and from each intermediary through which the Required Shares are or have been held during the Minimum Holding Period) verifying that, as of a date within seven calendar days prior to the date the Nomination Notice is delivered to or mailed and received by the Secretary of the Corporation in accordance with Section 13 of Article I, the Eligible Shareholder Owns, and has Owned continuously for the Minimum Holding Period, the Required Shares, and the Eligible Shareholder's agreement to provide, within five business days following the later of the record date for the determination of shareholders certified to vote at the annual meeting and the date notice of the record date is first publicly disclosed, one or more written statements from the record holder and such intermediaries verifying the Eligible Shareholder's continuous Ownership of the Required Shares through the record date;

(iii) a copy of the Schedule 14N that has been or is concurrently being filed with the Securities and Exchange Commission as required by Rule 14a-18 under the Exchange Act;

(iv) a representation and agreement that the Eligible Shareholder (A) will continue to hold the Required Shares through the date of the annual meeting, (B) acquired the Required Shares in the ordinary course of business and not with the intent to change or influence control of the Corporation, and does not presently have such intent, (C) has not nominated and will not nominate for election to the Board of Directors at the annual meeting any person whom it has not requested be included in the Corporation's proxy materials pursuant to this Section 8, (D) has not engaged and will not engage in, and has not and will not be a "participant" in another person's, "solicitation" within the meaning of Rule 14a-1(l) under the Exchange Act in support of the election of any individual as a director at the annual meeting other than its Shareholder Nominee(s) or a nominee of the Board of Directors, (E) has not distributed and will not distribute to any shareholder of the Corporation any form of proxy for the annual meeting other than the form distributed by the Corporation, (F) has complied and will comply with all laws and regulations applicable to solicitations and the use, if any, of soliciting material in connection with the annual meeting and (G) has provided and will provide facts, statements and other information in all communications with the Corporation and its shareholders that are or will be true and correct in all material respects and do not and will not omit to state a material fact necessary in order to make the statements made, in light of the circumstances under which they were made, not misleading;

(v) an undertaking that the Eligible Shareholder agrees to (A) assume all liability stemming from any legal or regulatory violation arising out of the Eligible Shareholder's

communications with the shareholders of the Corporation or out of the information provided to the Corporation by or on behalf of the Eligible Shareholder, (B) indemnify and hold harmless the Corporation and each of its directors, officers and employees individually against any liability, loss or damages in connection with any threatened or pending action, suit or proceeding, whether legal, administrative or investigative, against the Corporation or any of its directors, officers or employees arising out of any nomination of any person for election to the Board of Directors submitted by or on behalf of the Eligible Shareholder or any solicitation or other activity in connection therewith, and (C) file with the Securities and Exchange Commission any solicitation or other communication with the shareholders of the Corporation relating to the meeting at which its Shareholder Nominee(s) will be nominated, regardless of whether any such filing is required under Regulation 14A of the Exchange Act or whether any exemption from filing is available for such solicitation or other communication under Regulation 14A of the Exchange Act;

(vi) a completed questionnaire, representation and agreement required pursuant to Section 14 of Article I;

(vii) if the Eligible Shareholder consists of a group of shareholders, the designation by all group members of one member of the group that is authorized to receive communications, notices and inquiries from the Corporation and to act on behalf of all members of the group with respect to all matters relating to the request under this Section 8 (including withdrawal of the nomination); and

(viii) if two or more funds that are part of the same Qualifying Fund Group are intended to be counted as one shareholder for purposes of qualifying as an Eligible Shareholder, documentation reasonably satisfactory to the Corporation that demonstrates that the funds are part of the same Qualifying Fund Group.

(f) Additional Required Information. In addition to the information required pursuant to Section 8(e) of this Article II or any other provision of these By-Laws, the Corporation may require (i) any proposed Shareholder Nominee requested to be included in the Corporation's proxy materials to furnish any other information (A) that may reasonably be requested by the Corporation to determine whether the Shareholder Nominee would be independent under the Independence Standards (as defined in Section 8(i) of this Article II), (B) that could be material to a reasonable shareholder's understanding of the independence, or lack thereof, of such Shareholder Nominee or (C) that may reasonably be requested by the Corporation to determine the eligibility of such Shareholder Nominee to be included in the Corporation's proxy materials pursuant to this Section 8 or to serve as a director of the Corporation, and (ii) any Eligible Shareholder to furnish any other information that may reasonably be requested by the Corporation to verify the Eligible Shareholder's continuous ownership of the Required Shares for the Minimum Holding Period and through the date of the annual meeting.

(g) Supporting Statement. The Eligible Shareholder may, at its option, provide to the Secretary of the Corporation, at the time the Nomination Notice is provided, a written statement, not to exceed 500 words, in support of its Shareholder Nominee(s)' candidacy (a "Supporting Statement"). Only one Supporting Statement may be submitted by an Eligible Shareholder (including any group of shareholders together constituting an Eligible Shareholder) in support of its Shareholder Nominee(s). Notwithstanding anything to the contrary contained in this Section 8, the Corporation may omit from its proxy materials any information or Supporting Statement (or portion thereof) that it, in good faith, believes would violate any applicable law, rule or regulation.

(h) Correction of Defects; Updates and Supplements. In the event that any information or communications provided by or on behalf of an Eligible Shareholder or a Shareholder Nominee to the Corporation or its shareholders ceases to be true and correct in all material respects or omits to state a material fact necessary to make the statements made, in light of the circumstances under which they were made, not misleading, such Eligible Shareholder or Shareholder Nominee, as the case may be, shall promptly notify the Secretary of the Corporation of any such defect and of the information that is required to correct any such defect. Without limiting the forgoing, an Eligible Shareholder must provide immediate notice to the Corporation if the Eligible Shareholder ceases to Own any of the Required Shares prior to the date of the annual meeting. For the avoidance of doubt, no notification, update or supplement provided pursuant to this Section 8(h) shall be deemed to cure any defect in any previously provided information or communications or limit the remedies available to the Corporation relating to any such defect (including the right to omit a Shareholder Nominee from its proxy materials pursuant to this Section 8).

(i) Shareholder Nominee Eligibility. Notwithstanding anything to the contrary contained in this Section 8, the Corporation shall not be required to include in its proxy materials, pursuant to this Section 8, a Shareholder Nominee (i) who would not be an independent director under the rules and listing standards of the United States securities exchanges upon which the capital stock of the Corporation is listed or traded, any applicable rules of the Securities and Exchange Commission, or any publicly disclosed standards used by the Board of Directors in determining and disclosing the independence of the Corporation's directors (collectively, the "Independence Standards"), (ii) whose election as a member of the Board of Directors would cause the Corporation to be in violation of these By-Laws, the Articles of Organization, the rules and listing standards of the United States securities exchanges upon which the capital stock of the Corporation is listed or traded, or any applicable law, rule or regulation, (iii) who is or has been, within the past three years, an officer or director of a competitor, as defined in Section 8 of the Clayton Antitrust Act of 1914, (iv) who is a named subject of a pending criminal proceeding (excluding traffic violations and other minor offenses) or has been convicted in such a criminal proceeding within the past 10 years, (v) who is subject to any order of the type specified in Rule 506(d) of Regulation D promulgated under the Securities Act of 1933, as amended, or (vi) who shall have provided any information to the Corporation or its shareholders that was untrue in any material respect or that omitted to state a material fact necessary to make the statements made, in light of the circumstances in which they were made, not misleading.

(j) Omission and Removal of Shareholder Nominees. Notwithstanding anything to the contrary set forth herein, if (i) a Shareholder Nominee and/or the applicable Eligible Shareholder breaches any of its representations, agreements or undertakings or fails to comply with any of its obligations under this Section 8 or Section 13 of Article I, or (ii) a Shareholder Nominee otherwise becomes ineligible for inclusion in the Corporation's proxy materials pursuant to this Section 8 or dies, becomes disabled or otherwise becomes ineligible or unavailable for election at the annual meeting, in each case as determined by the Board of Directors or the presiding officer of the annual meeting, then (A) the Corporation may omit or, to the extent feasible, remove the information concerning such Shareholder Nominee and the related Supporting Statement from its proxy materials and otherwise communicate to its shareholders that such Shareholder Nominee will not be eligible for election at the annual meeting and, (B) the Corporation shall not be required to include in its proxy materials any successor or replacement nominee proposed by the applicable Eligible Shareholder or any other Eligible Shareholder.

(k) Restrictions on Re-Nominations. Any Shareholder Nominee who is included in the Corporation's proxy materials for a particular annual meeting of shareholders but either (i) withdraws from or becomes ineligible or unavailable for election at the annual meeting, or (ii) does not receive at least 10% of the votes cast in favor of such Shareholder Nominee's election, will be ineligible to be included in the Corporation's proxy materials pursuant to this Section 8 for the next two annual meetings of shareholders.

(l) General. This Section 8 provides the exclusive method for a shareholder to include nominees for election to the Board of Directors in the Corporation's proxy materials (other than with respect to Rule 14a-19 of the Exchange Act to the extent applicable with respect to the form of proxies).

Section 9. Other Committees. The Board of Directors may, by vote of a majority of the directors then in office, elect from their number other committees and may delegate to any such committee or committees some or all of the powers of the Board of Directors except those powers which by law, by the Articles of Organization, or by these By-Laws they are prohibited from delegating. Except as the Board of Directors may otherwise determine, each committee may make rules for the conduct of its business, but unless otherwise provided by the Board of Directors or such rules, its business shall be conducted as nearly as may be in the same manner as is provided by these By-Laws for the conduct of business by the Board of Directors. The Board of Directors shall have the power to rescind any vote, resolution, or other action of any committee, provided that the rights of third parties shall not be impaired by such rescission.

Section 10. Regular Meetings. Regular meetings of the Board of Directors may be held without call or notice at such places and at such times as the Board of Directors may, from time to time, determine, provided that notice of the first regular meeting following any such determination shall be given to absent directors.

Section 11. Special Meetings. Special meetings of the Board of Directors may be held at any time and at any place designated in the call of the meeting, when called by the Chair of the Board, the Chief Executive Officer, the President, or by three or more directors.

Section 12. Notice of the Meetings. It shall be sufficient notice to a director of a meeting of the Board of Directors (i) to send notice by mail at least forty-eight (48) hours before the meeting, addressed to such directors at such director's usual or last known business or residence address, (ii) to send notice by electronic mail (to the electronic mail address designated by such director) at least twenty-four (24) hours before the meeting, or (iii) to give notice to such director in person or by telephone at least twenty-four (24) hours before the meeting. A director may waive any notice before or after the date and time of the meeting. The waiver shall be in writing, signed by the director entitled to the notice, or in the form of an electronic transmission by the director to a representative of the Corporation, and filed with the minutes or corporate records. A director's attendance at or participation in a meeting waives any required notice to such director of the meeting unless the director at the beginning of the meeting, or promptly upon such director's arrival, objects to holding the meeting or transacting business at the meeting and does not thereafter vote for or assent to action taken at the meeting. Neither notice of a meeting nor a waiver of a notice need specify the purposes of the meeting.

Section 13. Quorum of Directors. At any meeting of the Board of Directors, a majority of the directors then in office shall constitute a quorum. Any meeting may be adjourned from time to time by a majority of the votes cast upon the question, whether or not a quorum is present, and the meeting may be held as adjourned without further notice.

Section 14. Action by Vote. When a quorum is present at any meeting, a majority of the directors present may take any action, except when a larger vote is required by law, by the Articles of Organization, or by these By-Laws.

Section 15. Action by Written Consent. Unless the Articles of Organization otherwise provide, any action required or permitted to be taken at any meeting of the Board of Directors or of any committee thereof may be taken without a meeting if all the directors or members of the committee as the case may be, consent to the action. The action must be evidenced by one or more consents describing the action taken, in writing, signed by each director or delivered to the Corporation by electronic transmission, and included in the minutes or filed with the corporate records reflecting the action taken. Such consents shall be treated for all purposes as a vote taken at a meeting.

Section 16. Participation Through Communications Equipment. Unless otherwise provided by law or the Articles of Organization, members of the Board of Directors or of any committee thereof may participate in a meeting of such Board or committee, as the case may be, through conference telephone or similar communications

equipment by means of which all persons participating in the meeting can hear each other at the same time, and participation by such means shall constitute presence in person at a meeting.

Section 17. Compensation of Directors. The Board of Directors may provide for the payment to any of the directors, other than officers or employees of the Corporation, of a specified amount for services as a director or member of a committee of the Board of Directors, or of a specified amount for attendance at each regular or special Board of Directors or committee meeting or of both, and all directors shall be reimbursed for expenses of attendance at any such meeting; provided, however, that nothing herein contained shall be construed to preclude any director from serving the Corporation in any other capacity and receiving compensation therefor.

ARTICLE III

OFFICERS AND AGENTS

Section 1. Enumeration; Qualification. The officers of the Corporation shall be a Chief Executive Officer, a President, a Treasurer, a Secretary, who may also be referred to in these By-Laws as the Secretary, and such other officers, including, without limitation, an Executive Chair of the Board (if Chair of the Board is an executive officer), one or more Vice Presidents, Assistant Treasurers, and Assistant Secretaries as the Board of Directors from time to time may in their discretion determine. In addition, the Corporation shall have such other agents as may be appointed by management in accordance with these By-Laws. Any two or more offices may be held by the same person.

Section 2. Powers. Subject to law, to the Articles of Organization, and to the other provisions of these By-Laws, each officer shall have, in addition to the duties and powers herein set forth, such duties and powers as are commonly incident to such officer's office and such duties and powers as the Board of Directors may from time to time designate.

Section 3. Election. The Chief Executive Officer, the President, the Treasurer, the Secretary and such other officers as the Board of Directors shall determine shall be elected annually by the Board of Directors at their first meeting following the annual meeting of the shareholders. Other officers, if any, may be elected or appointed by the Board of Directors at said meeting or at any other time.

Section 4. Tenure. Except as otherwise provided by law, by the Articles of Organization, or by these By-Laws, the Chief Executive Officer, the President, the Treasurer, and the Secretary shall hold office until their respective successors are chosen and qualified, and each other officer shall hold office for such term as may be designated in the vote electing or appointing such officer, or in each case until such officer sooner dies, resigns, is removed, or becomes disqualified.

Section 5. Chief Executive Officer. The Chief Executive Officer shall, subject to the oversight of the Board of Directors, have general charge and supervision of the business of the Corporation and, except as the Board of Directors shall otherwise determine, shall preside at all meetings of the shareholders. Unless otherwise determined by the Board of Directors, the Chief Executive Officer shall have the authority to appoint such agents, in addition to those officers enumerated in Section 3 of this Article III as being elected or appointed by the Board of Directors, as the Chief Executive Officer shall deem appropriate and to define their respective duties and powers.

Section 6. President and Vice Presidents. The President shall have the duties and powers specified in these By-Laws and shall have such other duties and powers as may be determined by the Board of Directors.

The Vice Presidents shall have such duties and powers as shall be designated from time to time by the Board of Directors. Unless the Board of Directors otherwise determines, one Vice President shall be designated as the Chief Financial Officer of the Corporation and shall have the duties and powers commonly incident thereto.

Section 7. Treasurer and Assistant Treasurers. The Treasurer shall have general responsibility for the corporate treasury function, shall be in charge of its funds and valuable papers, books of account, and accounting records, and shall have such other duties and powers as may be designated from time to time by the Board of Directors.

Any Assistant Treasurer shall have such duties and powers as shall be designated from time to time by the Board of Directors or the Treasurer.

Section 8. Secretary and Assistant Secretaries. The Secretary shall record all proceedings of the shareholders and Board of Directors in a book or series of books to be kept for that purpose, which book or books shall be kept as the principal office of the Corporation and shall be open at all reasonable times to the inspection of any shareholder. In the absence of the Secretary from any meeting of the shareholders or Board of Directors, an Assistant Secretary, or if there be none or the Assistant Secretary is absent, a temporary secretary chosen at the meeting, shall record the proceedings thereof in the aforesaid book.

Any Assistant Secretaries shall have such other duties and powers as shall be designated from time by the Board of Directors or the Secretary.

ARTICLE IV

CAPITAL STOCK

Section 1. Stock Certificates. The Board of Directors may authorize the issue without certificates of some or all of the shares of any or all of the Corporation’s classes or series of stock. Except to the extent the Board of Directors has determined to issue shares without certificates, a shareholder shall be entitled to a certificate stating the number and the class and the designation of the series, if any, of the shares held by such shareholder, in such form as shall, in conformity to law, be prescribed from time to time by the Board of Directors. Such certificate shall be signed by the President or a Vice President and by the Treasurer or an Assistant Treasurer. Such signatures may be facsimile if the certificate is signed by a transfer agent, or by a registrar, other than a director, officer, or employee of the Corporation. In case any officer who has signed or whose facsimile signature has been placed on such certificate shall have ceased to be such officer before such certificate is issued, it may be issued by the Corporation with the same effect as if such former officer were such officer at the time of its issue.

Every certificate for shares of stock which are subject to any restriction on transfer pursuant to the Articles of Organization, these By-Laws, or any agreement to which the Corporation is a party shall have the existence of the restriction noted conspicuously on the certificate and shall also set forth on the face or back either a summary of the restriction or a statement of the existence of such restriction and a statement that the Corporation will, upon written request, furnish a copy thereof to the holder of such certificate without charge.

Every certificate issued when the Corporation is authorized to issue more than one class or series of stock shall set forth on its face or back either a summary of the preferences, voting powers, qualifications, and special and relative rights of the shares of each class and series authorized to be issued or a statement of the existence of such preferences, powers, qualifications, and rights and a statement that the Corporation will, upon written request, furnish a copy thereof to the holder of such certificate without charge.

Section 2. Lost Certificates. In the case of the alleged loss, destruction, or mutilation of a certificate of stock, a duplicate certificate may be issued in place thereof, upon such conditions as the Board of Directors may prescribe. When authorizing such issue of a new certificate, the Board may in its discretion require the owner of such lost, destroyed, or mutilated certificate, or such owner's legal representative, to give the Corporation a bond, with or without surety, sufficient in the Board's opinion to indemnify the Corporation against any loss or claim that may be made against it with request to the certificate alleged to have been lost, destroyed, or mutilated.

Section 3. Transfer of Shares. Subject to the restrictions, if any, stated or noted on the stock certificates, shares of stock may be transferred on the books of the Corporation by the surrender to the Corporation or its transfer agent of the certificate therefor properly endorsed or accompanied by a written assignment and power of attorney properly executed with necessary transfer stamps affixed, and with such proof of the authenticity of signature as the Board of Directors or the transfer agent of the Corporation may reasonably require. Except as may be otherwise required by law, by the Articles of Organization, or by these By-Laws, the Corporation shall be entitled to treat the record holder of stock as shown on its on its books as the owner of such stock for all purposes, including the payment of dividends and the right to receive notice and to vote with respect thereto, regardless of any transfer, pledge, or other disposition of such stock, until the shares have been transferred on the books of the stock, until the shares have been transferred on the books of the Corporation in accordance with the requirements of these By-Laws.

Section 4. Record Date and Closing Transfer Books. The Board of Directors may fix in advance a time, which shall not be more than sixty (60) days before the date of any meeting of shareholders or the date for the payment of any dividend or making of any distribution to shareholders or the last day on which the consent or dissent of shareholders may be effectively expressed for any purpose, as the record date for determining the shareholders having the right to notice of and to vote at such meeting and any adjournment thereof or the right to receive such dividend or distribution or the right to give such consent or dissent, and in such case only shareholders

of record on such record date shall have such right, notwithstanding any transfer of stock on the books of the Corporation after the record date; or without fixing such record date the Board of Directors may for any such purposes close the transfer books for all or any part of such period.

If no record date is fixed and the transfer books are not closed, the record date for determining shareholders having the right to notice of or to vote at a meeting of shareholders shall be at the close of business on the date next preceding the day on which notice is given, and the record date for determining shareholders for any other purpose shall be at the close of business on the date on which the Board of Directors acts with respect thereto.

ARTICLE V

INDEMNIFICATION

Section 1. Directors and Officers. The Corporation shall indemnify, and advance funds to pay for or reimburse the reasonable expenses incurred by, its directors and the officers that have been appointed by the Board of Directors (including persons who serve at its request as directors, officers, or trustees of another organization in which it has any interest, direct or indirect, as a shareholder, creditor, or otherwise or who serve at its request in any capacity with respect to any employee benefit plan) to the fullest extent permitted by law, and may indemnify, and advance funds to pay for or reimburse the reasonable expenses incurred by, such other employees and agents as are identified by the Board of Directors.

The right of indemnification hereby provided shall not be exclusive of or affect any other rights to which any director or officer may be entitled. As used in this section, the terms “director” and “officer” include their respective heirs, executors, and administrators, an “interested” director or officer is one against whom in such capacity the proceedings in question or another proceeding on the same or similar grounds is then pending or threatened, and a “disinterested” director is one against whom no such proceeding is then pending or threatened. Nothing contained in this section shall affect any rights to indemnification to which corporate personnel other than directors and officers may be entitled by contract or otherwise under law.

The Board of Directors may authorize the purchase and maintenance of insurance, in such amounts as the Board of Directors may from time to time deem appropriate, on behalf of any person who is or was a director or officer or agent of the Corporation, or who is or was serving at the request of the Corporation as a director, officer, or agent of another organization in which it has any interest, direct or indirect, as a shareholder, creditor, or otherwise, or with respect to any employee benefit plan, against any liability incurred by such person in any such capacity, or arising out of such person’s status as such, whether or not such person is entitled to indemnification by the Corporation pursuant to this Article V or otherwise and whether or not the Corporation would have the power to indemnify such person against such liability.

ARTICLE VI

MISCELLANEOUS

Section 1. Corporate Seal. The seal of the Corporation shall be in such form as the Board of Directors may from time to time determine.

Section 2. Fiscal Year. The fiscal year of the Corporation shall be such period as shall from time to time be determined by the Board of Directors.

Section 3. Execution of Documents. Except as the Board of Directors may generally or in specific instances authorize the execution thereof in some other manner, all deeds, leases, transfers, contracts, bonds, notes, and other obligations of the Corporation shall be executed by the Chair of the Board, the President, any Vice President, or the Treasurer or such other individual as may be designated from time to time by such officers.

Section 4. Voting of Securities. Except as the Board of Directors may generally or in specific instances direct otherwise, the Chair of the Board, the President, any Vice President, or the Treasurer shall have the power, in the name and on behalf of the Corporation, to waive notice of, appoint any person or persons to act as proxy or attorney-in-fact of the Corporation (with or without power of substitution) to vote at, or attend and act for the Corporation at, any meeting of holders of shares or other securities of any other organization of which the Corporation holds shares or securities.

Section 5. Appointment of Auditor. The Board of Directors, or a committee thereof, shall each year select independent public accountants to report to the shareholders on the financial statements of the Corporation for such year. The selection of such accountants shall be presented to the shareholders for their approval at the annual meeting each year; provided, however, that if the shareholders shall not approve the selection made by the Board, the Board shall appoint other independent public accountants for such year.

ARTICLE VII

AMENDMENTS

These By-Laws may be altered, amended, or repealed, and new By-Laws not inconsistent with any provision of the Articles of organization or applicable statute may be made either by the affirmative vote of a majority of the voting power of the then outstanding shares of capital stock of the Corporation entitled to vote generally in the election of directors, voting together as a single class, at any annual or special meeting of the shareholders called for the purpose, or (except with respect to any provision hereof which by law, the Articles of Organization, or these By-Laws requires action by the shareholders) by the affirmative vote of a majority of the

Board of Directors then in office. Not later than the time of giving notice of the meeting of shareholders next following the making, amending, or repealing by the Board of Directors of any By-Law, notice thereof stating the substance of such change shall be given to all shareholders entitled to vote on amending the By-Laws. Any By-Law made, amended, or repealed by the Board of Directors may be altered, amended, repealed, or reinstated by the shareholders.

DESCRIPTION OF SECURITIES REGISTERED PURSUANT TO SECTION 12 OF THE SECURITIES EXCHANGE ACT OF 1934

Vertex Pharmaceuticals Incorporated (the "Company" or "Vertex") has one class of securities registered under Section 12 of the Securities Exchange Act of 1934, as amended (the "Exchange Act"): our common stock, par value $0.01 per share ("Common Stock").

DESCRIPTION OF CAPITAL STOCK

The following summary of our capital stock is based on the provisions of the Massachusetts Business Corporation Act (the "MBCA"), our Restated Articles of Organization, as amended (the "Articles"), and our Amended and Restated By-laws, as amended (the "By-laws"). This description does not purport to be complete and is subject to, and qualified in its entirety by reference to the full text of our Articles and our By-laws, each of which is filed and incorporated by reference as an exhibit to our Annual Report on Form 10-K, of which this Exhibit is a part, and the MBCA. You should read our Articles and Bylaws and the applicable provisions of the MBCA for a complete statement of provisions described under this caption "Description of Capital Stock" and for other provisions that may be important to you**.**

Authorized Capital Shares

Our authorized capital stock consists of 500,000,000 shares of Common Stock and 1,000,000 shares of preferred stock, par value $0.01 per share ("Preferred Stock"). The number of authorized shares of any class may be increased or decreased by an amendment to our Articles proposed by our board of directors and approved by a majority of the shares entitled to vote on the issue at a meeting at which a quorum exists.

Description of Common Stock

Dividend Rights

After satisfaction of any dividend rights of holders of Preferred Stock, holders of Common Stock are entitled ratably to any dividend declared by our board of directors out of funds legally available for this purpose.

Voting Rights

Each shareholder of record of our Common Stock is entitled to one vote for each share held on every matter properly submitted to the shareholders for their vote. Generally, a matter submitted for shareholder action shall be approved with a majority of the votes properly cast, except when a larger vote is required by law, our Articles or our By-laws. Other than in a contested election where directors are elected by a plurality vote, a director nominee shall be elected to the board of directors if the votes properly cast in favor of election of a director exceed the votes properly withheld in such election.

Holders of our Common Stock do not have cumulative voting rights.

Liquidation Rights

Upon our liquidation, dissolution or winding up, the holders of our Common Stock are entitled to receive ratably our net assets available, if any, after the payment of all debts and other liabilities and subject to the prior rights of any outstanding preferred stock.

Other Rights and Preferences

Holders of our Common Stock have no preemptive, subscription, redemption, conversion or exchange rights and no sinking fund provisions. There are no restrictions on alienability of our Common Stock or liabilities to further calls or assessments by the Company.

The rights, preferences and privileges of holders of Common Stock are subject to, and may be adversely affected by, the rights of the holders of shares of any series of preferred stock that we may designate and issue in the future.

Anti-Takeover Effects of Provisions of Massachusetts Law, the Articles and By-Laws

Massachusetts Anti-Takeover Law and Control Share Acquisition Law

We are subject to Chapter 110F of the Massachusetts General Laws, an anti-takeover law. In general, this statute prohibits a publicly-held Massachusetts corporation from engaging in a "business combination" with an "interested shareholder" for a period of three years after the date of the transaction in which the person becomes an interested shareholder, unless (i) prior to the date such shareholder became an interested shareholder, the board of directors approved the business combination or transaction which resulted in the shareholder becoming interested, (ii) the interested shareholder acquires 90% of the outstanding voting stock of the corporation (excluding shares held by certain affiliates of the corporation) at the time it becomes an interested shareholder, or (iii) the business combination is approved by both the board of directors and at least two-thirds of the outstanding voting stock of the corporation (excluding shares held by the interested shareholder). Generally, an "interested shareholder" is a person who, together with affiliates and associates, owns (or at any time within the prior three years did own) 5% or more of the outstanding voting stock of the corporation. A "business combination" includes a merger, a stock or asset sale, and certain other transactions resulting in a financial benefit to the interested shareholders.

We are subject to Chapter 110D of the Massachusetts General Laws, entitled "Regulation of Control Share Acquisitions." In general, this statute provides that any shareholder of a corporation subject to this statute who acquires 20% or more of the outstanding voting stock of a corporation may not vote such stock unless the shareholders of the corporation so authorize. The board of directors may amend our by-laws to exclude us from this statute prospectively.

Removal of Directors

The Company's Articles provides that the directors may be removed from office by shareholder vote at any time, but only for cause, by the affirmative vote of the holders of a majority of the voting power of the then outstanding shares of capital stock of the Company entitled to vote generally in the election of directors, voting together as a single class. Any director may also be removed from office for cause by vote of a majority of the directors then in office.

Special Shareholder Meeting

The Company's By-Laws provide that a special meeting of the shareholders may be called at any time by the chair of the board, the president, or the board of directors. A special meeting of the shareholders shall also be called by the secretary upon written application of one or more shareholders who hold at least forty percent in interest of the capital stock entitled to vote at the meeting.

Action by Written Consent

The Company's By-Laws provide that any action required or permitted to be taken at any meeting of the shareholders may be taken without a meeting, but only if all shareholders entitled to vote on the matter consent to the action in writing and the written consents are filed with the records of meetings of shareholders.

Requirements for Advanced Notification of Shareholder Nominations and Proposals

The Company's By-Laws establish advance notice procedures with respect to shareholder proposals and nomination of candidates for election as directors other than nominations made by or at the direction of its board of directors or a committee of its board of directors.

NASDAQ Listing

Our Common Stock is listed on the NASDAQ Global Select Market under the symbol “VRTX.”

AMENDMENT NO. 2 TO EMPLOYMENT AGREEMENT

This AMENDMENT NO. 2 is made and entered into effective as of February 8, 2023 (the "Effective Date") to the employment agreement dated as of April 1, 2020, as amended effective as of February 7, 2022 (the "Employment Agreement"), between Vertex Pharmaceuticals Incorporated (the "Company") and Jeffrey M. Leiden, MD., Ph.D. (the "Executive").

NOW, THEREFORE, in consideration of the mutual covenants set forth herein, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Company and Executive agree as follows:

1. That Section 2 of the Employment Agreement is hereby amended by deleting "March 31, 2024" and replacing it with "March 31, 2025".

2. That Section 3(d) of the Employment Agreement is hereby amended by deleting "2024" and replacing it with "2025".

3. That Section 4(c) of the Employment Agreement is hereby amended in its entirety by replacing it with the following:

"(c) Equity Awards. During the Term of this Agreement, and provided that the Executive has remained in continuous service with the Company through the applicable grant date, subject to the approval of the Board or the Compensation Committee thereof, the Executive will receive the following annual grants of equity awards (the "Annual Stock Awards"). Each Annual Stock Award will be made during the applicable time period set forth below. Fifty percent (50%) of each Annual Stock Award will be in the form of fully vested shares of Company common stock and fifty percent (50%) will be in the form of performance stock units and the Annual Stock Award will have an aggregate grant date value (with performance stock units valued based on target, and the number of shares or units granted, as applicable, determined by dividing such values by the fair market value of the Company's common stock) as follows:

(i) $9,000,000 for fiscal year 2020 (to be granted in the first calendar quarter of 2021) ("Year 1");

(ii) $8,500,000 for fiscal year 2021 (to be granted in the first calendar quarter of 2022) ("Year 2");

(iii) $6,500,000 for fiscal year 2022 (to be granted in the first calendar quarter of 2023) ("Year 3");

(iv) $6,500,000 for fiscal year 2023 (to be granted in the first calendar quarter of 2024) ("Year 4"); and

(v) $6,500,000 for fiscal year 2024 (to be granted in the first calendar quarter of 2025) ("Year 5").

Both one-year and three-year performance criteria will apply to the performance stock units granted in Year 1, and one-year performance criteria will apply to the performance stock units granted in Year 2, Year 3, Year 4 and Year 5. The terms and conditions applicable to each Annual Stock Award shall otherwise be as prescribed by the Compensation Committee, with each Annual Stock Award evidenced by an award agreement that is substantially similar to the form of award agreement used for such type of award for Company executives generally, except for such changes as are necessary or desirable to reflect the terms of the Executive's employment hereunder."

4. That Section 4(d) of the Employment Agreement is hereby amended by replacing the final sentence of such Section in its entirety with the following:

   "In order to facilitate the Executive's receipt of benefits under the Employee Benefit Plans in 2022, 2023, 2024 and 2025, the Company will make a cash payment to the Executive of (i) $65,000 in February 2022, (ii) $67,000 in February 2023, and (iii) in each of February 2024 and February 2025 an amount to be determined by the Board or the Compensation Committee thereof to maintain for the Executive substantially similar levels of benefits under the Employee Benefit Plans as were provided to the Executive in 2022."

5. Except as amended hereby and expressly provided herein, the Employment Agreement shall remain in full force and effect.

IN WITNESS WHEREOF, this Amendment No. 2 has been executed as a sealed instrument by the Company, by its duly authorized representative, and by the Executive, as of the date first above written.

THE COMPANY:	THE EXECUTIVE:
VERTEX PHARMACEUTICALS INCORPORATED	
/s/ Bruce I. Sachs	/s/Jeffrey M. Leiden
Bruce I. Sachs Lead Independent Director and Chairman of MDCC	Jeffrey M. Leiden, M.D., Ph.D

Vertex Employee Compensation Plan

On an annual basis, the Management Development and Compensation Committee of our Board of Directors adopts an employee compensation plan for our officers and other employees, including our named executive officers, together with performance goals for that fiscal year. The plan addresses three components of employee compensation—base salary, performance bonuses, which serve as short-term incentives, and equity grants, which serve as long-term incentives—that are designed to motivate, reward and retain employees by aligning compensation with the achievement of strategic corporate goals.

Upon completion of each performance period (usually a calendar year), our Board of Directors assigns a performance rating on the basis of achievement of goals for the company set by the Board, in consultation with our chief executive officer, early in the performance period. The amount available for payment of performance bonuses is established on the basis of this performance rating, and is allocated to employees on the basis of salary tier and individual performance rating. The base salaries of the executive officers are set based on market and other competitive factors. Merit increases to base salaries for other employees are made on the basis of individual performance rating. Annual equity grants, made in the form of restricted stock grants or units, are made on the basis of grade level and individual performance.

The Board of Directors retains broad discretion to determine the appropriate form and level of compensation, particularly for our executives, on the basis of its assessment of our executives, the demand for talent, our performance and other factors. Key corporate performance factors generally include, among other things, achievement of regulatory and commercialization goals, research and development productivity, enhancements of organizational capabilities, financial goals, manufacturing, quality and operations, and other aspects of our performance. We reserve the right to modify the plan, and the key corporate performance factors and criteria under the plan, at any time.

Exhibit 21.1

Subsidiaries of Vertex Pharmaceuticals Incorporated

Vertex Pharmaceuticals (San Diego) LLC, a Delaware limited liability company

Vertex Pharmaceuticals (Distribution) Incorporated, a Delaware corporation

Vertex Pharmaceuticals (Cayman) Limited, a Cayman Islands company (2)

Vertex Pharmaceuticals (Cayman III) Limited, a Cayman Islands company (4)

Vertex Pharmaceuticals (Cayman 509) Limited, a Cayman Islands company

Vertex Pharmaceuticals (Cayman 765) Limited, a Cayman Islands company

Vertex Pharmaceuticals (Cayman 787) Limited, a Cayman Islands company

Vertex Pharmaceuticals (Delaware) LLC, a Delaware limited liability company

Vertex Pharmaceuticals (Puerto Rico) LLC, a Delaware limited liability company

Vertex Pharmaceuticals (Canada) Incorporated, a Canadian company (1)

Vertex Pharmaceuticals (Singapore) Pte. Ltd., a Singapore company

Vertex Holdings, Inc., a Delaware corporation

Vertex Pharmaceuticals (Europe) Limited, a United Kingdom company (5)

Vertex Pharmaceuticals (Ireland) Limited, an Irish company (5)

Vertex Pharmaceuticals (U.K.) Limited, a United Kingdom company (5)

Vertex Pharmaceuticals (France) SAS, a French company

Vertex Pharmaceuticals (Germany) GmbH, a German company

Vertex Pharmaceuticals (Australia) Pty. Ltd., an Australian company

Vertex Pharmaceuticals (Spain), S.L., a Spanish company

Vertex Pharmaceuticals (Netherlands) B.V., a Dutch company

Vertex Pharmaceuticals (Italy) S.r.L., an Italian company

Vertex Farmaceutica do Brasil LTDA, a Brazilian company (3)

Vertex Pharmaceuticals GmbH, an Austrian company (5)

Vertex Pharmaceuticals (Portugal), Unipessoal Lda., a Portuguese company (5)

Vertex Pharmaceuticals (CH) GmbH, a Swiss company (5)

Vertex Pharmaceuticals (Sweden) AB, a Sweden company (5)

Vertex Pharmaceuticals Single Member Societe Anonyme, a Greek company (5)

Vertex Pharmaceuticals (Poland) sp. z.o.o., a Polish company (4) (5)

The Vertex Foundation, Inc., a Delaware corporation

Torreyana Insurance Company, Inc., a Vermont corporation

Vertex Pharmaceuticals (Czech Republic) s.r.o, a Czech company (5)

Vertex Pharmaceuticals (Belgium) BV, a Belgian company (5)

Plum Cove Capital LLC, a Delaware limited liability company

ViaCyte, Inc., a Delaware corporation

ViaCyte Georgia, Inc., a Delaware corporation (6)

Encap, Inc., a Delaware corporation (6)

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(1) a subsidiary of Vertex Pharmaceuticals (Delaware) LLC
(2) a subsidiary of Vertex Holdings, Inc.
(3) a subsidiary of Vertex Pharmaceuticals (U.K.) Limited
(4) a subsidiary of Vertex Pharmaceuticals (Cayman) Limited
(5) a subsidiary of Vertex Pharmaceuticals (Europe) Limited
(6) a subsidiary of ViaCyte, Inc.

Exhibit 23.1

Consent of Independent Registered Public Accounting Firm

We consent to the incorporation by reference in the following Registration Statements:

(1) Registration Statement (Form S-3 No. 333-262606) of Vertex Pharmaceuticals Incorporated,

(2) Registration Statements (Form S-8 Nos. 333-134482, 333-150946, 333-160442, 333-166803 and 333-184787) pertaining to the Vertex Pharmaceuticals Incorporated Amended and Restated 2006 Stock and Option Plan (formerly known as the Vertex Pharmaceuticals Incorporated 2006 Stock and Option Plan),

(3) Registration Statements (Form S-8 Nos. 333-184784 and 333-232945) pertaining to the Vertex Pharmaceuticals Incorporated Employee Stock Purchase Plan, and

(4) Registration Statements (Form S-8 Nos. 333-188737, 333-197466, 333-206075, 333-219559, 333-226363, 333-232948 and 333-266582) pertaining to the Amended and Restated Vertex Pharmaceuticals Incorporated 2013 Stock and Option Plan (formerly known as the Vertex Pharmaceuticals Incorporated 2013 Stock and Option Plan);

of our reports dated February 10, 2023, with respect to the consolidated financial statements of Vertex Pharmaceuticals Incorporated and the effectiveness of internal control over financial reporting of Vertex Pharmaceuticals Incorporated, included in this Annual Report (Form 10-K) of Vertex Pharmaceuticals Incorporated for the year ended December 31, 2022.

/s/ Ernst & Young LLP

Boston, Massachusetts
February 10, 2023

Exhibit 31.1

CERTIFICATION

I, Reshma Kewalramani, certify that:

1. I have reviewed this Annual Report on Form 10-K of Vertex Pharmaceuticals Incorporated;

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 and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: February 10, 2023

/s/ Reshma Kewalramani

Reshma Kewalramani

Chief Executive Officer and President

Exhibit 31.2

CERTIFICATION

I, Charles F. Wagner, Jr., certify that:

1. I have reviewed this Annual Report on Form 10-K of Vertex Pharmaceuticals Incorporated;

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 and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: February 10, 2023

/s/ Charles F. Wagner, Jr.

Charles F. Wagner, Jr.
Executive Vice President and Chief Financial Officer

Exhibit 32.1

SECTION 906 CEO/CFO CERTIFICATION

Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 (Subsections (a) and (b) of Section 1350, Chapter 63 of Title 18, United States Code) each of the undersigned officers of Vertex Pharmaceuticals Incorporated, a Massachusetts corporation (the "Company"), does hereby certify, to such officer's knowledge, that:

The Annual Report on Form 10-K for the year ended December 31, 2022 (the "Form 10-K") of the Company fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934, and the information contained in the Form 10-K fairly presents, in all material respects, the financial condition and results of operations of the Company.

Date: February 10, 2023

/s/ Reshma Kewalramani

Reshma Kewalramani
Chief Executive Officer and President

Date: February 10, 2023

/s/ Charles F. Wagner, Jr.

Charles F. Wagner, Jr.
Executive Vice President and Chief Financial Officer