VERTEX PHARMACEUTICALS INC / MA
Form 10-K
February 13, 2019

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 10-K

x ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the Fiscal Year Ended December 31, 2018

or

o 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	Name of Each Exchange on Which Registered
Common Stock, $0.01 Par Value Per Share	The Nasdaq Global Select Market

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

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Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes x No o
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 o No x
Indicate by check mark whether the registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes x No o

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

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

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, 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 x Accelerated filer o Non-accelerated filer o Smaller reporting company o
Emerging growth company o

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. o

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

The aggregate market value of the registrant's common stock held by non-affiliates of the registrant (without admitting that any person whose shares are not included in such calculation is an affiliate) based on the last reported sale price of the common stock on June 29, 2018 (the last trading day of the registrant's second fiscal quarter of 2018) was $42.5 billion. As of January 31, 2019, the registrant had 255,656,889 shares of common stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the definitive Proxy Statement for the 2019 Annual Meeting of Shareholders to be held on June 5, 2019 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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"We," "us," "Vertex" and the "Company" 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®" and "SYMKEVI®" 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.

PART I

ITEM 1. BUSINESS

OVERVIEW

We invest in scientific innovation to create transformative medicines for people with serious diseases. Our business is focused on developing and commercializing therapies for the treatment of cystic fibrosis, or CF, and advancing our research and development programs in other diseases.

Cystic Fibrosis

Our goal is to develop treatment regimens that will provide benefits to all patients with CF and will enhance the benefits that currently are being provided to patients taking our medicines. Our marketed medicines are SYMDEKO/SYMKEVI (tezacaftor in combination with ivacaftor), ORKAMBI (lumacaftor in combination with ivacaftor) and KALYDECO (ivacaftor). These three medicines are collectively approved to treat approximately half of the 75,000 CF patients in North America, Europe and Australia.

We believe the triple combination regimens of next-generation correctors in combination with tezacaftor and ivacaftor that we are evaluating in Phase 3 clinical development could potentially provide benefits to all CF patients who have at least one F508del mutation in their cystic fibrosis transmembrane conductance regulator, or CFTR, gene (approximately 90% of all CF patients). This would provide (i) the first treatment for the underlying cause of CF for patients who have one copy of the F508del mutation in their CFTR gene and a second mutation that results in minimal CFTR function, whom we refer to as F508del/Min patients; and (ii) an improved treatment option for a majority of patients who are currently eligible for our products.

In the fourth quarter of 2018, we reported positive data from our Phase 3 clinical trials evaluating the triple combination of VX-659, tezacaftor and ivacaftor. In the first quarter of 2019, we expect to report data from the Phase 3 clinical trials evaluating the triple combination of VX-445, tezacaftor and ivacaftor and select the better of the two regimens for potential regulatory approval. We expect to submit a New Drug Application, or NDA, to the United States Food and Drug Administration, or FDA, for a triple combination regimen no later than mid-2019.

Research and Development

We invest in research and development in order to discover and develop transformative medicines for people with serious diseases. Our goal is to identify and develop new medicines by combining transformative advances in the understanding of human disease and in the science of therapeutics to dramatically advance human health. We have a number of earlier-stage development programs that we are conducting independently or in collaboration with third parties, including:

- Pain. We are evaluating VX-150, a NaV1.8 inhibitor, in Phase 2 clinical development as a potential treatment for pain. We have obtained proof-of-concept data from Phase 2 clinical trials evaluating VX-150 in acute, chronic inflammatory and neuropathic pain. We have an ongoing Phase 2b dose-ranging clinical trial in acute pain, which, if successful, could support the initiation of Phase 3 development.
- Sickle cell disease and beta-thalassemia. We are co-developing CTX001, an investigational gene editing treatment, for the treatment of beta-thalassemia and sickle cell disease, with CRISPR Therapeutics AG, or CRISPR. We recently initiated two Phase 1/2 clinical trials to evaluate CTX001.
- Alpha-1 Antitrypsin Deficiency. In December 2018, we initiated a Phase 1 clinical trial for a novel drug candidate that is a potential treatment for alpha-1 antitrypsin, or AAT, deficiency.

We plan to continue investing in our research and development programs and fostering scientific innovation. We have advanced research programs to identify additional drug candidates for CF, pain, and AAT deficiency, as well as other serious diseases, including focal segmental glomerulosclerosis, or FSGS. We also have a number of earlier-stage research programs directed at other serious diseases. We believe that pursuing research in diverse areas allows us to balance the risks inherent in drug development and may provide drug candidates that will form our pipeline in future years.

CYSTIC FIBROSIS

Background

CF is a life shortening genetic disease affecting approximately 75,000 people in North America, Europe and Australia. CF is 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 of the two of the most prevalent mutations, the F508del mutation or the G551D 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. The G551D mutation results in a defect in the CFTR protein in which the defective protein reaches the surface of a cell but does not efficiently transport chloride ions across the cell membrane.

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 VX-561 increase the open probability of the CFTR protein channels on the cell surface, increasing the flow of salt and water into and out of the cell. CFTR correctors, such as lumacaftor, tezacaftor, VX-659 and VX-445, help CFTR proteins reach the cell surface.

Our Medicines

Our medicines, SYMDEKO/SYMKEVI, ORKAMBI and KALYDECO, are collectively approved to treat approximately half of the 75,000 CF patients in North America, Europe and Australia. Our approved medicines, including information regarding the applicable indication and the age groups for which the medicine has been approved, are set forth in the table below.

Product	Scientific Name	Region/ Initial Approval	Indication	Eligible Age Group
	ivacaftor/tezacaftor	U.S. (2018)	CF patients (i) homozygous for the F508del mutation or (ii) with one copy of certain mutations that result in residual CFTR activity	12 years of age and older
	ivacaftor/tezacaftor	European Union (2018)	CF patients (i) homozygous for the F508del mutation and (ii) with one copy of the F508del mutation and one copy of certain mutations that result in residual CFTR activity	12 years of age and older
	ivacaftor/lumacaftor	U.S. (2015)	CF patients homozygous for the F508del mutation	2 years of age and older
	ivacaftor/lumacaftor	European Union (2015)	CF patients homozygous for the F508del mutation	2 years of age and older
	ivacaftor	U.S. (2012)	CF patients with G551D and other specified mutations	1 year of age and older
	ivacaftor	European Union (2012)	CF patients with G551D and other specified mutations	1 year of age and older

In addition to the European Union and the United States, we market our products in additional countries, including Australia and Canada. We continuously seek to increase the number of patients eligible to receive our current medicines through label expansions. Activities in support of our label expansion efforts include:

- We have obtained positive data from a Phase 3 clinical trial evaluating tezacaftor in combination with ivacaftor in patients with CF six to eleven years of age who are F508del homozygous or who have one copy of the F508del mutation and one mutation that results in residual CFTR activity. The clinical trial met its primary safety endpoint,

and safety data showed that the combination was generally well tolerated. We submitted a supplemental new drug application, or sNDA, for these patients to the FDA in the fourth quarter of 2018. To support potential approval in the European Union, an eight-week Phase 3 clinical trial is ongoing to evaluate tezacaftor in combination with ivacaftor in approximately 65 children six to eleven years of age. The primary endpoint of the clinical trial is the absolute change in the lung clearance index.

- In October 2018, we announced positive data from a Phase 3 clinical trial of ivacaftor in patients with CF six to less than twelve months of age. We submitted a sNDA to the FDA and a line extension to the EMA in late 2018.

Triple Combination Programs

We believe the triple combination regimens of a next-generation corrector in combination with tezacaftor and ivacaftor that we are evaluating in Phase 3 clinical development could potentially provide benefits to all CF patients who have at least one F508del mutation in their cystic fibrosis transmembrane conductance regulator, or CFTR, gene (approximately 90% of all CF patients). The Phase 3 development programs for VX-659 and VX-445 that we initiated in the first half of 2018 are evaluating F508del/Min patients and F508del homozygous patients 12 years of age and older. We more recently initiated Phase 3 clinical trials for triple combinations containing VX-659 and VX-445 in F508del/Min and F508del homozygous patients who are six to eleven years of age.

Each of the VX-659 and VX-445 triple combination Phase 3 development programs in patients 12 years of age and older is comprised of two clinical trials. The first clinical trial in each program was designed to enroll approximately 360 F508del/Min patients. In the U.S., the primary efficacy endpoint of the first clinical trial in each program is the mean absolute change from baseline in percent predicted forced expiratory volume in one second, or ppFEV1, at week four of treatment with the triple combination regimen versus placebo. The second clinical trial in each program was designed to enroll approximately 100 F508del homozygous patients. The primary efficacy endpoint of the second clinical trial in each program is the mean absolute change from baseline in ppFEV1 at week four of treatment with the triple combination regimen compared to tezacaftor in combination with ivacaftor.

VX-659 Triple Combination Phase 3 Clinical Data

The triple combination of VX-659, tezacaftor and ivacaftor resulted in statistically significant improvements in lung function in two Phase 3 clinical trials. Data from a pre-specified interim analysis of the Phase 3 clinical trials in F508del/Min patients showed a mean absolute improvement in ppFEV1 of 14.0 percentage points from baseline at week 4 of treatment compared to placebo ($p<0.0001$). In the Phase 3 clinical trial in F508del homozygous patients, data demonstrated that the addition of VX-659 in patients already receiving tezacaftor and ivacaftor resulted in a mean absolute improvement in ppFEV1 of 10.0 percentage points from baseline at week 4 of treatment compared to the control group in whom placebo was added to tezacaftor and ivacaftor ($p<0.0001$). The VX-659 triple combination regimen was generally well tolerated, and the safety and efficacy profile from the results support the potential submission of an NDA for the VX-659 triple combination regimen.

Expected VX-445 Triple Combination Phase 3 Clinical Data

Enrollment is complete for the two Phase 3 clinical trials of the triple combination of VX-445, tezacaftor and ivacaftor in in F508del/Min patients and F508del homozygous patients. We expect to report data from both Phase 3 clinical trials of the VX-445 triple combination regimen in the first quarter of 2019.

Expected Regulatory Submissions

The data expected in the first quarter of 2019 for the VX-445 triple combination and the data reported in the fourth quarter of 2018 for the VX-659 triple combination are anticipated to enable us to choose the better of the two regimens to submit for potential global regulatory approvals. We believe these data will provide the basis for a submission of an NDA to the FDA for a triple combination regimen no later than mid-2019. Subsequent to the NDA filing, we intend to make regulatory submissions in markets outside the United States.

VX-121

In addition, we have initiated a Phase 1/2 clinical trial to evaluate VX-121, an additional next-generation corrector.

RESEARCH AND DEVELOPMENT PROGRAMS

We invest in research and development in order to discover and develop transformative medicines for people with serious diseases. Our goal is to identify and develop new medicines by combining transformative advances in the understanding of

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human disease with the science of therapeutics to dramatically advance human health. Our approach to drug discovery has focused on the research and development of small molecule drugs, which has been validated through our success in moving novel small molecule drug candidates into clinical trials and obtaining marketing approvals for KALYDECO, ORKAMBI and SYMDEKO/SYMKEVI for the treatment of CF and INCIVEK (telaprevir) for the treatment of hepatitis C infection. Over the last several years, we have expanded our research capabilities to include additional innovative therapeutic approaches with a focus on nucleic acid-based therapies. In addition to our approved medicines, we have a number of drug candidates that we are developing independently or that are being developed by collaborators pursuant to collaboration agreements.

We are applying the experience we gained developing medicines for CF to guide our current investments in research and development programs by:

- generating biological assays and identifying clinical biomarkers that we believe will be predictive of clinical responses;
- targeting the discovery and development of medicines that have the potential to offer transformative benefit;
- identifying efficient clinical and regulatory paths to bring new medicines to patients; and
- focusing on treatments for life-threatening diseases with a high unmet medical need.

In addition to continuing our research to identify additional drug candidates for the treatment of CF, we are focusing our research and development efforts on developing products for the treatment serious diseases including sickle cell disease, beta-thalassemia, pain, AAT deficiency, FSGS and other diseases.

To augment our internal programs, we seek to 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 as well as to access technologies needed to execute on our strategy. We have established 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.

Pain

We are developing VX-150, an inhibitor of the sodium channel 1.8 (Nav 1.8), as a potential treatment for pain. We have obtained positive results from three Phase 2 clinical trials of VX-150:

- In the first quarter of 2017, we announced data from a 14-day Phase 2 randomized, double-blind, placebo-controlled, clinical trial of VX-150 in patients with chronic pain from osteoarthritis of the knee.
- In the first quarter of 2018, we announced data from a Phase 2 randomized, double-blind, placebo-controlled clinical trial evaluating VX-150 as a treatment for patients with acute pain following bunionectomy surgery.
- In the fourth quarter of 2018, we announced data from a Phase 2 randomized, double-blind, placebo-controlled clinical trial evaluating VX-150 as a treatment for patients with pain caused by small fiber neuropathy.

A Phase 2b dose-ranging study of VX-150 in patients with acute pain following bunionectomy surgery is currently ongoing to support potential pivotal development in acute pain. We have multiple pain molecules in late-stage preclinical development and plan to initiate clinical development of the first of these molecules in 2019.

Sickle Cell Disease and Beta-Thalassemia

We are co-developing CTX001, an investigational gene editing treatment, for the treatment of hemoglobinopathies, with CRISPR Therapeutics. Hemoglobinopathies are a group of inherited blood disorders that result from variations in the synthesis or structure of hemoglobin, a protein in red blood cells that delivers oxygen and removes carbon dioxide throughout the body. We are seeking to develop a CRISPR/Cas9-based therapy to treat both beta-thalassemia and sickle cell disease. These diseases are caused by mutations in the gene encoding the beta-globin protein, which is an essential component of hemoglobin.

We and CRISPR have initiated and are enrolling patients in Phase 1/2 clinical trials to evaluate CTX001 in beta-thalassemia and sickle cell disease. The first two patients in each clinical trial will be dosed sequentially and, pending data from these initial two patients, subsequent patients can be dosed concurrently.

Alpha-1 Antitrypsin Deficiency

We are seeking to develop medicines to treat AAT deficiency. In December 2018, we initiated a Phase 1 clinical trial for a novel drug candidate that is a potential treatment for AAT deficiency. AAT deficiency is a disease that affects approximately 100,000 people in the United States and Europe. AAT deficiency is caused by a defective AAT protein resulting from mutations in the SERPINA1 gene. To develop AAT deficiency, children must inherit two defective SERPINA1 alleles (one from each parent). The mutation results in a defect in the AAT protein in which the protein does not fold correctly. This folding defect can cause the AAT protein to accumulate in the liver (where it is produced), which can cause liver damage. As a result, sufficient levels of the protein fail to reach other organs, particularly the lungs, where it would typically protect them from the harmful effects of certain enzymes. This can cause damage to lung tissue and may lead to emphysema or chronic pulmonary obstructive disease, among other things.

Focal Segmental Glomerulosclerosis

We are conducting research to identify drug candidates to treat the underlying biology of FSGS, a kidney disease. FSGS is a rare disease that attacks the kidney's filtering units causing serious scarring that leads to permanent kidney damage. FSGS is a leading cause of nephrotic syndrome in children and kidney failure in adults. We may advance our first drug candidate for FSGS into clinical development in 2019.

Influenza

Janssen Pharmaceuticals, Inc., or Janssen, is developing pimodivir as a potential treatment for the influenza A virus. We exclusively licensed pimodivir to Janssen in 2014. Janssen is conducting Phase 3 clinical trials of pimodivir in combination standard of care treatment in patients who are hospitalized or are outpatients at a higher risk of influenza-related complications.

COMMERCIALIZATION OF OUR MEDICINES

Commercial Organization

Our commercial organization focuses on supporting sales of 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 and obtaining reimbursement for our products from third-party payors, including governmental organizations in the United States and ex-U.S. markets.

Our U.S. field-based CF commercial team is comprised of a small number of individuals whom we believe is sufficient to support commercialization of our medicines for CF. We focus our CF marketing efforts in the United States 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 United States focused on the treatment of CF. In international markets, we have small sales forces that promote KALYDECO, ORKAMBI and SYMKEVI in jurisdictions where these products are approved.

We market our products through personal interactions with physicians and allied health care professionals. In addition, 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 policy-makers. We also have established programs in the United States that provide our products to qualified uninsured or underinsured patients at no charge or at a reduced charge, based on specific eligibility criteria.

Reimbursement

Sales of our products depend, to a large degree, on the extent to which our products will be covered by third-party payors, such as government health programs, commercial insurance and managed health care organizations. These third-party payors increasingly are reducing reimbursements for 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. Decreases in third-party reimbursement for a product or a decision by a third-party payor to not cover a product could

reduce physician usage of the product.

The Medicare Prescription Drug, Improvement, and Modernization Act of 2003, or the MMA, established the Medicare Part D program to provide 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. Unlike Medicare Part A and B, Part D coverage is not standardized. Part D prescription drug plan sponsors are not required to pay for all covered Part D drugs, and each drug plan can develop its own drug formulary that identifies which drugs it will cover and at what tier or level. However, Part D prescription drug formularies must include drugs within each therapeutic category and class of covered Part D drugs, though not necessarily all the drugs in each category or class. Any formulary used by a Part D prescription drug plan must be developed and reviewed by a pharmacy and therapeutic committee. Government payment for some of the costs of prescription drugs may increase demand for 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. Moreover, while the MMA applies only to drug benefits for Medicare beneficiaries, private payors often follow Medicare coverage policy and payment limitations in setting their own payment rates. Any reduction in payment that results from the MMA may result in a similar reduction in payments from non-governmental payors.

The American Recovery and Reinvestment Act of 2009 provided funding for the federal government to compare the effectiveness of different treatments for the same illness. A plan for the research was to be developed by the Department of Health and Human Services, or HHS, the Agency for Healthcare Research and Quality and the National Institutes of Health, and periodic reports on the status of the research and related expenditures were to be made to the U.S. Congress. 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. 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, or 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 is designed to expand and increase industry rebates for drugs covered under Medicaid programs, impose an annual fee on branded pharmaceutical manufacturers and make changes to the coverage requirements under the Medicare Part D program. The branded prescription drug fee is not tax deductible.

In Europe and many other foreign countries, the success of our products depends largely on obtaining and maintaining government reimbursement, because in many foreign countries, patients are unable to access prescription pharmaceutical products that are not reimbursed by their governments. Negotiating reimbursement rates in foreign countries can delay the commercialization of a pharmaceutical product and generally results in a reimbursement rate that is lower than the net price that companies can obtain for the same product in the United States.

In some countries, such as Germany and France, commercial sales of a new product can occasionally begin while the reimbursement rate that a company will receive is under discussion. In other countries, a company must complete the reimbursement discussions prior to the commencement of commercial sales of the pharmaceutical product. The requirements governing drug pricing vary widely from country to country. For example, the member states of the European Union can restrict the range of drugs for which their national health insurance systems provide reimbursement and can control the prices of drugs for human use. 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 profitability of the company placing the drug on the market. Recently, many countries in the European Union have increased the amount of discounts required on pharmaceuticals and these efforts could continue as countries attempt to manage healthcare expenditures, especially in light of the severe fiscal and debt crises experienced by many countries in the European Union. There can be no assurance that any country that has price controls or reimbursement limitations for pharmaceutical products will provide for reimbursement of our products, or such countries may only provide for reimbursement on terms that we do not deem adequate. Additionally, reimbursement discussions in ex-U.S. markets may take a significant period of time.

COLLABORATIONS AND STRATEGIC INVESTMENTS

As part of our business strategy, we seek to license or acquire drugs, drug candidates and other technologies that have the potential to complement our ongoing research and development efforts in CF, access emerging technologies and license or acquire pipeline assets with a focus on early-stage assets. In addition, we establish business relationships with collaborators to support our research activities and to lead or support development and/or commercialization of

certain drug candidates.

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 generally

have become responsible for the costs of research activities and obtained development and commercialization rights to resulting drug candidates. Depending on the terms of the arrangements, we 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 resulting from the collaboration. Alternatively, when we enter into a co-development arrangement, we generally agree to split costs and revenues associated with the relevant program. Our current in-license agreements include:

- CRISPR Therapeutics AG. In 2015, we entered into a collaboration with CRISPR for the discovery and development of potential new treatments aimed at the underlying genetic causes of human diseases using CRISPR-Cas9 gene editing technology. We currently are co-developing CTX001 for the treatment of sickle cell disease and beta-thalassemia and, if successful, have agreed to co-commercialize CTX001. In addition, we are collaborating with CRISPR on additional research targets, including CF, and will have the option to exclusively license the resulting therapeutics for these targets.
- Arbor Biotechnologies, Inc. In the fourth quarter of 2018, we entered into a collaboration with Arbor Biotechnologies, pursuant to which we are focusing on the discovery of novel proteins, including DNA endonucleases, to advance the development of new gene-editing therapies.
- Moderna Therapeutics, Inc. In 2016, we entered into a collaboration with Moderna Therapeutics, pursuant to which we are seeking to identify and develop messenger ribonucleic acid, or mRNA, therapeutics for the treatment of CF.
- Other Arrangements. In 2018, we entered into agreements with Genomics plc, Merck KGaA, Darmstadt, Germany, and X-Chem, Inc. in order to support our research efforts.

Out-license Agreements

We have entered into various agreements pursuant to which we have out-licensed rights to certain drug 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 drug candidates and obtain development and commercialization rights to these drug 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. Our current out-license agreements include:

- Janssen Pharmaceuticals, Inc. In 2014, we entered into an agreement with Janssen. Pursuant to this agreement, Janssen Inc. is developing pimodivir for the treatment of influenza. Janssen is evaluating pimodivir in Phase 3 clinical trials in patients with influenza A infection.
- Merck KGaA, Darmstadt, Germany. In 2017, we entered into a Strategic Collaboration and License Agreement with Merck KGaA, Darmstadt, Germany, pursuant to which we granted an exclusive worldwide license to research, develop and commercialize four oncology research and development programs.

Strategic Investments

In connection with our business development activities, we periodically make equity investments in our collaborators. We hold strategic equity investments in public companies including CRISPR and Moderna, as well as certain private companies, including Arbor Biotechnologies. We may make additional strategic equity investments in public or private companies in the future.

Cystic Fibrosis Foundation Therapeutics Incorporated

We have entered into collaborations with pharmaceutical and other companies and organizations that provided us financial and other resources, and that provided support for certain programs. In particular, in 2004 we entered into a collaboration agreement with Cystic Fibrosis Foundation, or CFF, 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 any approved drugs first synthesized and/or tested during a research term on or before February 28, 2014, including KALYDECO (ivacaftor), ORKAMBI (lumacaftor in combination with ivacaftor) and SYMDEKO/SYMKEVI (tezacaftor in combination with ivacaftor) 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 VX-659 and VX-445. For combination products, such as ORKAMBI and SYMDEKO/SYMKEVI, 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 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 market 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. Market exclusivity runs concurrently with patent exclusivity.

We own or hold exclusive licenses to several hundred patents in the United States. We own eight issued U.S. patents that cover the active pharmaceutical ingredients in KALYDECO, its marketed formulations, and/or its approved indication. We own 16 issued U.S. patents that cover the active pharmaceutical ingredients in ORKAMBI, its marketed formulations, and/or its approved indication. We own 17 issued U.S. patents that cover the active pharmaceutical ingredients in SYMDEKO, its marketed formulation, and/or its approved indication.

The table below sets forth the year of projected expiration for the basic product patents or pending patent applications covering each of our approved products and our drug candidates that have progressed at least into Phase 3 clinical trials. For products that are combinations of two or more active ingredients, the projected expiration of the latest expiring patent or application covering any of the active pharmaceutical ingredients is provided. 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 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/Drug Candidate	Status of United States Patent (Projected Expiration)	Status of European Union Patent (Projected Expiration)
KALYDECO	Granted (2027)	Granted (2025) [1]
ORKAMBI	Granted (2030)	Granted (2026) [2]
SYMDEKO/SYMKEVI	Granted (2027)	Granted (2028) [3]
VX-659/tezacaftor/ivacaftor	Pending (2037)	Pending (2037)
VX-445/tezacaftor/ivacaftor	Pending (2037)	Pending (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] We intend to apply in certain European countries for supplementary protection certificates for SYMKEVI, which we expect to expire in 2033.

In addition to our later-stage programs and marketed products, we actively monitor and file patent applications in the United States and in foreign countries on technology that is in the pre-clinical and early clinical stages. For example, we also own U.S. and foreign patents and patent applications covering the following:

- CF potentiators and correctors and many other related compounds, and the use of those compounds to treat CF.
- VX-150 and the use of VX-150 to treat pain indications.
- Other pre-clinical and clinical drug candidates and the use of such drug 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 cannot be certain, however, that issued patents will be enforceable or provide adequate protection or that pending patent applications will result in issued patents.

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.

MANUFACTURING

As we market and sell our approved products and advance our drug 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 an international network of third parties to manufacture and distribute our products for commercial sale and post-approval clinical trials and to manufacture and distribute our drug candidates for clinical trials. In addition to establishing supply chains for each new approved product, we need to adapt our supply chain for existing products to include additional formulations that are often required in order to treat younger patients. We currently are focused on finalizing the supply chain that will be required in order to commercialize our triple combination regimens, if approved, and ensuring the stability of the supply chains for our current products.

We expect that we will continue for the foreseeable future to rely on third parties to meet our commercial supply needs and a significant portion of our clinical supply needs. We have established our own small-scale manufacturing capabilities in Boston, which we use for clinical trial and commercial supplies.

Our supply chain for sourcing raw materials and manufacturing drug product ready for distribution 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. Establishing and managing this global supply chain for each of our drugs and drug candidates requires a significant financial commitment and the creation and maintenance of numerous third-party contractual relationships. To ensure the stability of our supply chains we aim to develop additional sources of manufacture for all steps of our manufacturing processes at the time of, or shortly after, marketing approval. Therefore, at any point in time, we may have a limited number of single source manufacturers for certain steps in our manufacturing processes, particularly for recently launched products.

In order to manufacture our commercial products, we utilize both continuous manufacturing technology as well as batch manufacturing processes. While continuous process manufacturing has been used in many industries, we believe that we are the first company to obtain FDA approval for a fully-continuous drug product manufacturing process.

We have developed systems and processes to track, monitor and oversee our third-party manufacturers' activities, including a quality assurance program intended to ensure that our third-party manufacturers comply with current Good Manufacturing Practices, or cGMP. 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.

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. Some of our competitors have substantially greater financial, technical 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 drug 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 drug

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 drug 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.

Cystic Fibrosis

A number of companies are seeking to identify and develop drug candidates for the treatment of CF, including public companies such as AbbVie, Eloxx Pharmaceuticals, ProQR Therapeutics, Proteostasis Therapeutics, and Translate Bio, and several private companies. Although we are the first company to successfully develop medicines that treat the underlying cause of CF, our products are collectively approved to treat only a portion of patients with CF and we believe that future treatment regimens, including our triple combination regimens, could deliver enhanced benefits to patients who are currently being treated with our medicines. Our competitors have research and development programs directed at identifying and developing CFTR potentiators, CFTR correctors and drug candidates with other mechanisms of action or that utilize new therapeutic approaches that seek to address the underlying cause of CF. Our competitors are exploring the development of drug candidates primarily as part of combination regimens of small molecules, and some competitors are exploring development of new therapeutic approaches, including nucleic acid-based therapies, which could provide a one-time treatment option for patients with CF. 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. If one or more competing therapies are successfully developed as a treatment for patients with CF, our revenues from our current products and/or additional CF products, if then approved, could face significant competitive pressure.

GOVERNMENT REGULATION

Our operations and activities are subject to extensive regulation by numerous government authorities in the United States, the European Union and other countries. In the United States, the European Union and other countries, drugs are subject to rigorous regulations governing the testing, manufacture, labeling, storage, record keeping, approval, advertising and promotion of our products. As a result of these regulations, product development and product approval processes are very expensive and time consuming. The regulatory requirements applicable to drug 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 Approval Processes

The process required by the FDA before a drug may be marketed in the United States generally involves the following:

- completion of preclinical laboratory tests, animal studies and formulation studies conducted according to Good Laboratory Practices, or GLP, and other applicable regulations;
- submission to the FDA of an IND application, which must become effective before clinical trials in the United States may begin;
- performance of adequate and well-controlled clinical trials according to Good Clinical Practices, or GCP, to establish the safety and efficacy of the proposed drug for its intended use;
- submission to the FDA of an NDA;
- satisfactory completion of an 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.

Once a drug candidate 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 candidate in humans.

Preclinical or nonclinical testing typically continues even after the IND is submitted.

If the FDA accepts the IND, the drug candidate can then be studied in human clinical trials to determine if the drug candidate is safe and effective. These 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 initially is introduced into healthy human subjects and tested for safety, dosage tolerance, absorption, metabolism, distribution and elimination. In the case of some drug candidates for severe or life-threatening diseases, such as cancer, especially when the drug candidate may be inherently too toxic to ethically administer to healthy volunteers, the initial human testing is often conducted in patients.
- Phase 2. Clinical trials are initiated in a limited patient population intended to identify possible adverse effects and safety risks, to preliminarily evaluate the efficacy of the drug candidate for specific targeted diseases and to determine dosage tolerance and optimal dosage.
- Phase 3. Clinical trials are undertaken to further evaluate dosage, clinical efficacy and safety in an expanded patient population at geographically dispersed clinical trial sites. These clinical trials are intended to establish the overall risk-benefit ratio of the drug candidate and provide an adequate basis for regulatory approval and product labeling.

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 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. All clinical trials must be conducted under the supervision of one or more qualified investigators in accordance with GCP. Progress reports detailing the results of the clinical trials must be submitted at least annually to the FDA and more frequently in other situations, including the occurrence of serious adverse events. Information about certain clinical trials must be submitted within specific time-frames to the National Institutes of Health for public dissemination on the www.clinicaltrials.gov website.

The results of drug development, preclinical studies and clinical trials, along with descriptions of the manufacturing process, analytical tests conducted on the chemistry of the drug candidate, proposed labeling and other relevant information are submitted to the FDA as part of an NDA requesting approval to market the drug candidate. The FDA reviews each NDA 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 for filing.

Once the submission is accepted for filing, the FDA begins an in-depth review. The FDA reviews an NDA to determine, among other things, whether a drug candidate is safe and effective for its intended use and whether its manufacturing is cGMP-compliant to assure and preserve the drug candidate’s identity, strength, quality and purity. The FDA may refer the NDA to an advisory committee for review and recommendation as to whether the NDA 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, the FDA will inspect the facility or facilities where the drug candidate is manufactured and tested. Additionally, before approving an NDA, 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 in its present form.

Biologics License Application Process

Certain of our drug candidates may be regulated by the FDA under the Food, Drug, and Cosmetic Act, or FDCA, and the Public Health Service Act as biologics. Biologics can present special safety, efficacy and manufacturing challenges that may differ from those present in the regulation of small molecule drugs. As such, while similar to the NDA review process described above, in lieu of filing an NDA, biologics require the submission of a Biologics License Application, or BLA, and approval of such BLA by the FDA prior to being marketed in the U.S.

Expedited Review and Approval

The FDA has developed four distinct approaches to make new drugs 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 or life-threatening 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

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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.

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 that are intended to treat a serious condition and preliminary clinical evidence indicates that the drug may demonstrate substantial improvement over available therapy on a clinically significant endpoint. For drugs and biologics that have been designated as Breakthrough Therapies, robust FDA-sponsor interaction and communication can help to identify the most efficient and expeditious path for clinical development while minimizing the number of patients placed in ineffective control regimens.

The FDA may grant “priority review” status to products 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. In complying with cGMP, manufacturers must devote substantial time, money and effort in the areas of production, quality control and quality assurance to maintain 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 enforcement action may be taken, which may include a warning letter 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 standards 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, under the FDCA the sponsor of an approved drug in the United States 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. 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 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 manufactured or distributed by us pursuant to FDA approvals are subject to continuing regulation by the FDA, including, among other things:

- record-keeping requirements;
- reporting of adverse experiences with the product;

- 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 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:

- 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 mitigation and evaluation strategy or other safety-related limitations;
- warning letters or "untitled letters";
- product seizures;
- total or partial suspension of production or distribution; or
- injunctions, fines, disgorgement, refusals of government contracts, or civil or criminal penalties.

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

Biologics are also entitled to exclusivity under the Biologics Price Competition and Innovation Act, which was passed as Title VII to the Patient Protection and Affordable Care Act, or the ACA. The law provides a pathway for approval of biosimilars following the expiration of 12 years of exclusivity for the innovator biologic and a potential additional 180 day-extension term for conducting pediatric studies. 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 those efforts continue in 2019 and if the ACA is repealed, substantially modified, or invalidated, it is unclear what, if any, impact such action would have on biosimilar regulation.

Under the Orphan Drug Act, the FDA may grant orphan drug designation to drug candidates intended to treat a rare disease or condition, which is generally a disease or condition that affects fewer than 200,000 people in the United States. KALYDECO, ORKAMBI and SYMDEKO have been granted designation as orphan drugs by the FDA.

If a drug candidate that has orphan drug designation subsequently receives the first FDA approval for that drug 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 indication 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 drug candidates for seven years if a competitor first obtains approval of the same product as defined by the FDA or if our drug candidate is determined to be contained within the competitor's product for the same indication or disease.

Foreign Regulation

We conduct clinical trials and market our products in numerous jurisdictions outside the United States. Most of these jurisdictions have clinical trial, product approval and post-approval regulatory processes that are similar in principle to those in the United States. Thus, whether or not we obtain FDA approval for a drug candidate, we must obtain approval by the comparable regulatory authorities of foreign countries or economic areas, such as the European Union, 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 European Union regulatory systems, a company may submit marketing authorization applications either under a centralized or decentralized procedure. The centralized procedure, which is compulsory for medicines produced by biotechnology or 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 European Union member states. In addition to the centralized procedure, Europe 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.

Other Regulations

Pharmaceutical companies are also subject to various laws pertaining to healthcare "fraud and abuse," including anti-kickback laws and false claims laws. Anti-kickback laws make it illegal to solicit, offer, receive or pay any remuneration in exchange 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 program. False claims laws prohibit 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 false claims laws may also arise when a violation of certain laws or regulations related to the underlying products (e.g., violations regarding improper promotional activity 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 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 or require disclosure to the government and public of such interactions. The laws include 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 ambiguous requirements. Outside the United States, 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, or 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, or 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 United Kingdom generally will be subject to the Bribery Act.

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 data privacy and protection, 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. The extent of government regulation, which might result from future legislation or administrative action, cannot accurately be predicted.

EMPLOYEES

As of December 31, 2018, we had approximately 2,500 employees, as compared to approximately 2,300 employees as of December 31, 2017. Of these employees, approximately 2,000 were based in the United States and approximately 500 were based outside the United States. Our employees are not covered by a collective bargaining agreement, except for a small number of employees outside the United States.

A key aspect of remaining competitive in our industry is recruiting and retaining employees, including employees with the scientific and technical expertise to conduct our research activities and advance our development programs and commercial expertise to effectively marketing our products. We consider our relations with our employees to be good and over the last several years have successfully recruited talented and diverse employees to support our expanding business. However, we continue to face intense competition for our personnel from our competitors and other companies throughout our industry and from universities and research institutions.

OTHER MATTERS

Financial Information and Significant Customers

Financial information about our revenue by product and major 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.

DIRECTORS AND EXECUTIVE OFFICERS OF THE REGISTRANT

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

Name	Age	Position
Jeffrey M. Leiden, M.D., Ph.D.	63	Chairman of the Board, Chief Executive Officer and President
David Altshuler, M.D., Ph.D.	54	Executive Vice President, Global Research and Chief Scientific Officer
Stuart A. Arbuckle	53	Executive Vice President and Chief Commercial Officer
Reshma Kewalramani, M.D.	46	Executive Vice President, Global Medicines Development and Medical Affairs, and Chief Medical Officer
Michael Parini, J.D.	44	Executive Vice President and Chief Legal and Administrative Officer
Amit K. Sachdev, J.D.	51	Executive Vice President and Chief Regulatory Officer
Paul M. Silva	52	Senior Vice President and Corporate Controller and Interim Chief Financial Officer
Sangeeta M. Bhatia, M.D., Ph.D.	50	Director
Alan Garber, M.D., Ph.D.	63	Director
Terrence C. Kearney	64	Director
Yuchun Lee	53	Director
Margaret G. McGlynn	59	Director
Bruce I. Sachs	59	Director
	71	Director

Elaine S. Ullian	74	Director
William Young		

Dr. Leiden is our Chairman, Chief Executive Officer and President. He has held the positions of Chief Executive Officer and President since February 2012 after joining us as CEO Designee in December 2011. 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 serves as a director of Quest Diagnostics Inc., a medical diagnostics company, and 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. 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, 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 and Chief Commercial Officer, a position he has held since September 2012. Prior to joining us, Mr. Arbuckle held multiple commercial leadership roles at Amgen, Inc., a 17,000 person biotechnology company, 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. Mr. Arbuckle holds a BSc in pharmacology and physiology from the University of Leeds.

Dr. Kewalramani is our Executive Vice President and Chief Medical Officer, a position she has held since April 2018. 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 Global Clinical Development, Nephrology & Metabolic Therapeutic Area and as Vice President, U.S. Medical Organization. Dr. Kewalramani is the industry representative to the FDA's Endocrine and Metabolic Drug Advisory Committee. 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.

Mr. Parini is our Executive Vice President and Chief Legal and Administrative Officer, a position he has held since January 2017. From January 2016 to January 2017, he was our Executive Vice President and Chief Legal Officer. From 2004 until he joined Vertex, Mr. Parini served in various roles of increasing responsibility at Pfizer Inc., a pharmaceutical company, most recently as Senior Vice President and Associate General Counsel. Prior to Pfizer, Mr. Parini was an attorney at Akin, Gump, Strauss, Hauer & Feld, L.L.P. Mr. Parini holds a B.A. from Georgetown University and a J.D. from the Georgetown University Law Center.

Mr. Sachdev is our Executive Vice President and Chief Regulatory Officer, a role he assumed in January 2017. He served as our Executive Vice President, Policy, Access and Value, from October 2014 through December 2016. 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. From 2010 through 2013 he established our first international commercial operations in Canada. 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 United States House of Representatives and practiced law at the Chemical Manufacturers Association, and subsequently at the law firm of Ropes & Gray LLP. Mr. Sachdev holds a B.S from Carnegie Mellon University, and a J.D. from Emory University School of Law.

Mr. Silva is our Senior Vice President and Corporate Controller, a position he has held since April 2011. In January 2019, Mr. Silva was appointed our interim Chief Financial Officer. Mr. Silva joined us in August 2007 as Senior Director, Accounting Operations and was our Vice President and Corporate Controller from September 2008 through April 2011. Prior to joining us, he was the Vice President, Internal Reporting at Iron Mountain Incorporated from July 2006 until August 2007 and a consultant to Iron Mountain's finance department from April 2005 until July 2006. He was the Finance Director of the Bioscience Technologies Division of Thermo Electron Corporation from 2002 to April 2005. Mr. Silva holds a B.S. in accounting from Assumption College.

Dr. Bhatia has been a member of our Board of Directors since June 2015. Dr. Bhatia is a professor at the Massachusetts Institute of Technology, or MIT, where she currently serves as the John J. and Dorothy Wilson Professor of Health Sciences & Technology/Electrical Engineering & Computer Science. For the 2018 year, Dr. Bhatia was on sabbatical from MIT as she served as a co-founder of Glympse Bio, a private company focused on developing in vivo sensing technology dedicated for disease monitoring. Prior to joining the Massachusetts Institute of Technology in 2005, Dr. Bhatia was a professor of bioengineering and medicine at the University of California at San Diego from 1998 through 2005. Dr. Bhatia also is an investigator for the Howard Hughes Medical Institute, a member of the Department of Medicine at Brigham and Women's Hospital, a member of the Broad Institute and a member of the Koch Institute for Integrative Cancer Research. Dr. Bhatia holds a Sc.B. in biomedical engineering from Brown University, an S.M. and Ph.D. in Mechanical Engineering from the Massachusetts Institute of Technology and an M.D. from Harvard Medical School.

Dr. Garber has been a member of our Board of Directors since June 2017. He is Provost of Harvard University and the Mallinckrodt Professor of Health Care Policy at Harvard Medical School, a Professor of Economics in the Faculty of Arts and Sciences, Professor of Public Policy in the Harvard Kennedy School of Government, and Professor in the Department of Health Policy and Management in the Harvard T.H. Chan School of Public Health. From 1998 until he joined Harvard in 2011, he was the Henry J. Kaiser Jr. Professor, a Professor of Medicine, and a Professor (by

courtesy) of Economics, Health Research and Policy, and of Economics in the Graduate School of Business at Stanford University. Dr. Garber is a member of the National Academy of Medicine, the American Society of Clinical Investigation, the Association of American Physicians, and the American Academy for Arts and Sciences. He is a Fellow of the American Association for the Advancement of Science, the American College of Physicians, and the Royal College of Physicians. Dr. Garber is also a

Research Associate with the National Bureau of Economic Research and served as founding Director of its Health Care Program for nineteen years. He also has served as a member of the National Advisory Council on Aging at the National Institutes of Health, as a member of the Board of Health Advisers of the Congressional Budget Office and as Chair of the Medicare Evidence Development and Coverage Advisory Committee at the Centers for Medicare and Medicaid Services. Dr. Garber has been a member of the Board of Directors of Exelixis, Inc., a biopharmaceutical company, since 2005. Dr. Garber holds an A.B. summa cum laude, an A.M. and a Ph.D., all in Economics, from Harvard University, and an M.D. with research honors from Stanford University.

Mr. Kearney has been a member of our Board of Directors since May 2011. Mr. Kearney served as the Chief Operating Officer of Hospira, Inc., a specialty pharmaceutical and medication delivery company, from April 2006 to January 2011. From April 2004 to April 2006, he served as Hospira's Senior Vice President, Finance, and Chief Financial Officer, and he served as Acting Chief Financial Officer through August 2006. Mr. Kearney served as Vice President and Treasurer of Abbott Laboratories from 2001 to April 2004. From 1996 to 2001, Mr. Kearney was Divisional Vice President and Controller for Abbott's International Division. Mr. Kearney serves as a member of the Board of Directors at Acceleron Pharma Inc., a biopharmaceutical company. He served as a member of the Board of Directors of Innovia (formerly known as Theravance, Inc.), a royalty management company, from October 2014 through April 2016, and as member of the Board of Directors of AveXis, Inc., a gene therapy company, from January 2016 until its acquisition in May 2018. Mr. Kearney has been a member of the Board of Directors of Levo Therapeutics, Inc., a biotechnology company focused on developing treatments for Prader-Willi Syndrome, since 2018. He received his B.S. in biology from the University of Illinois and his M.B.A. from the University of Denver.

Mr. Lee has been a member of our Board of Directors since September 2012. Mr. Lee serves as an Executive in Residence (XIR) and Partner of General Catalyst Partners, a venture capital firm, positions he has held since April of 2013. Mr. Lee also serves as the Chief Executive Officer of Allego, Inc. and is Executive Chairman of Clarabridge, Inc. Mr. Lee was the Vice President of IBM's Enterprise Marketing Management Group from November 2010 through January 2013. Mr. Lee co-founded Unica Corporation, a provider of software and services used to automate marketing processes, in 1992, and was Unica's President and/or Chief Executive Officer from 1992 through November 2010, when Unica was acquired by IBM. From 1989 to 1992, Mr. Lee was a senior consultant at Digital Equipment Corporation, a supplier of general computing technology and consulting services. Mr. Lee holds a B.S. and an M.S. in electrical engineering and computer science from the Massachusetts Institute of Technology and an M.B.A. from Babson College.

Ms. McGlynn has been a member of our Board of Directors since May 2011. Ms. McGlynn retired from Merck & Co. in 2009, where she served as President, Vaccines and Infectious Diseases from and as President, Hospital and Specialty Products. During her 26 year career at Merck, she also held various leadership roles in the U.S. and globally in marketing, sales, managed care and business development. Following her retirement, Ms. McGlynn served as the President and Chief Executive Officer of the International AIDS Vaccine Initiative, a global not-for-profit organization whose mission is to ensure the development of safe, effective and accessible HIV vaccines for use throughout the world, from 2011 until 2015. Ms. McGlynn serves as a member of the Board of Directors for Air Products and Chemicals, Inc., a company specializing in gases and chemicals for industrial uses, and Amicus Therapeutics, Inc., a biopharmaceutical company. She is also a member of the National Industrial Advisory Committee at the University at Buffalo School of Pharmacy and Pharmaceutical Sciences. Ms. McGlynn holds a B.S. in Pharmacy and an M.B.A. in Marketing from the State University of New York at Buffalo.

Mr. Sachs has been a member of our Board of Directors since 1998. Mr. Sachs is a General Partner at Charles River Ventures, a venture capital firm he joined in 1999. From 1998 to 1999, he served as Executive Vice President and General Manager of Ascend Communications, Inc. From 1997 until 1998, Mr. Sachs served as President and Chief Executive Officer of Stratus Computer, Inc. From 1995 to 1997, he served as Executive Vice President and General Manager of the Internet Telecom Business Group at Bay Networks, Inc. From 1993 to 1995, he served as President and Chief Executive Officer of Xylogics, Inc. Mr. Sachs holds a B.S.E.E. in electrical engineering from Bucknell University, an M.E.E. in electrical engineering from Cornell University, and an M.B.A. from Northeastern University.

Ms. Ullian has been a member of our Board of Directors since 1997. Ms. Ullian served as President and Chief Executive Officer of Boston Medical Center, a private, not-for-profit, 626-bed, academic medical center with a

community-based focus, from 1996 through January 2010. From 1994 to 1996, she served as President and Chief Executive Officer of Boston University Medical Center Hospital. From 1987 to 1994, Ms. Ullian served as President and Chief Executive Officer of Faulkner Hospital. She also serves as a director of Thermo Fisher Scientific Inc. Ms. Ullian retired from Hologic, Inc.'s Board of Directors in March 2018. Ms. Ullian holds a B.A. in political science from Tufts University and an M.P.H. from the University of Michigan.

Mr. Young has been a member of our Board of Directors since May 2014. Mr. Young is a Senior Advisor with Blackstone Life Sciences (which acquired Clarus Ventures in 2018). Mr. Young joined Clarus Ventures, a life sciences venture capital firm, in 2010. Prior to Clarus Ventures, Mr. Young served from 1999 until June 2009 as the Chairman and Chief Executive Officer of Monogram Biosciences, Inc., a biotechnology company acquired by Laboratory Corporation of America in June 2009. From 1980 to 1999, Mr. Young was employed at Genentech, Inc. in positions of increasing responsibility, including as Chief Operating Officer from 1997 to 1999, where he was responsible for all product development, manufacturing and commercial functions. Prior to joining Genentech, Mr. Young was with Eli Lilly & Co. for 14 years. Mr. Young currently serves as the Chairman of the Board of Directors of NanoString Technologies, Inc., and as a member of the Board of Directors of Theravance BioPharma Inc. Mr. Young retired from BioMarin Pharmaceutical Inc.'s Board of Directors in November 2015 and as Biogen's Chairman of the Board in June 2014. Mr. Young holds a B.S. in Chemical Engineering from Purdue University, an M.B.A. from Indiana University and an Honorary Doctorate in Engineering from Purdue University. Mr. Young was elected to the National Academy of Engineering in 1993 for his contributions to biotechnology.

ITEM 1A. RISK FACTORS

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.

Risks Related to Our Business

All of our product revenues and the vast majority of our total revenues are derived from sales of medicines for the treatment of cystic fibrosis. If we are unable to continue to increase revenues from sales of our cystic fibrosis medicines, 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 CF medicines. SYMDEKO/SYMKEVI, ORKAMBI and KALYDECO net product revenues represented approximately 25%, 41% and 33% of our total revenues in the year ended December 31, 2018, respectively. As a result, our future success is dependent on our ability to continue to increase revenues from sales of our CF medicines. In the near term, this will require us to increase CF net product revenues from our current medicines and in the longer term, this will require us to successfully develop, obtain approval for and commercialize at least one triple combination therapy that will allow us to treat F508del/Min patients and to improve the treatment options available to patients with CF who are eligible for our current medicines.

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

- that one or more competing therapies may successfully be developed as a treatment for patients with CF;
- that we may experience adverse developments with respect to development or commercialization of our CF medicines and/or CF drug candidates; and
- 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.

If one or more 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 stock price would likely decline.

We are investing significant resources in the development of our next-generation CFTR corrector compounds in triple combinations and if we are unable to show the safety and efficacy of these regimens, experience delays in doing so or are unable to successfully commercialize at least one of these medicines, our business would be materially harmed.

We are investing significant resources in the development of our next-generation CFTR corrector compounds, VX-659 and VX-445, which are currently being evaluated in Phase 3 clinical development as part of separate triple combination treatment regimens for patients with CF. We believe that a significant portion of the long-term value attributed to our company by investors is based on the commercial potential of these triple combination therapies. While we believe, based on data, including interim data, from the ongoing VX-659 Phase 3 clinical trials and the status of the ongoing VX-445 clinical trials, that we will be able to submit an NDA to the FDA for a triple combination regimen no later than mid-2019, there can be no assurances that the data will be sufficient to submit an NDA on this timeline, or at all.

Clinical trial data are subject to differing interpretations and, even if we view data as sufficient to support the safety, effectiveness and/or approval of a triple combination regimen, regulatory authorities may disagree and may require additional data, may limit the scope of the approval or may deny approval altogether. Furthermore, interim results of a clinical trial may differ materially from final results from such clinical trials. If the final data from our ongoing Phase 3 clinical trials are not favorable, the FDA and comparable foreign regulatory authorities may not approve these treatment regimens and/or we may be forced to delay or terminate the development of these treatment regimens, which would have an adverse effect on our business. Even successfully completed large-scale clinical trials may not result in marketable medicines. If a triple combination fails to achieve its primary endpoint in clinical trials, if safety issues arise, or if the results from our clinical trials are otherwise inadequate to support regulatory approval of our triple combination therapies, commercialization of that combination regimen could be delayed or halted.

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Even if we gain marketing approval for one or more combination therapies containing a next-generation CFTR corrector compound in a timely manner, we cannot be sure that such combination therapy will be commercially successful. In addition, since we expect that a significant portion of the patients for whom a triple combination treatment regimen would be indicated would also be eligible for our then-existing medicines, a portion of the revenues from our triple combination regimens will likely displace revenues from our then-marketed products, reducing the overall positive effect of the commercialization of our triple combination regimens on our total revenues.

If the anticipated or actual timing of marketing approvals for these triple combination regimens, or the market acceptance of these triple combination regimens, if approved, including treatment reimbursement levels agreed to by third-party payors, do not meet the expectations of investors or public market analysts, the market price of our common stock would likely decline.

We have experienced challenges commercializing products outside of the United States, 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. Given recent global economic pressures and geopolitical uncertainty, government authorities throughout the world are increasingly attempting to limit or regulate the price of drug products. The reimbursement process in ex-U.S. markets can take a significant period of time and reimbursement decisions are made on a country-by-country basis.

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. Particular attention is being paid by payors, including government and private payors, to these types of medicines given the relative higher cost of these products as compared to other types of pharmaceutical products - and countries are increasingly refusing to reimburse costly medicines. As a result, we have recognized limited ex-U.S. net product revenues for ORKAMBI in various countries outside the United States, including the United Kingdom and France, both of which represent significant potential markets for ORKAMBI. Our future product revenues, including from ORKAMBI, SYMKEVI and our triple combination regimens, if approved, depend on, among other things, our ability to complete reimbursement discussions in ex-U.S. markets for our products. There is no assurance that coverage and reimbursement will be available outside of the United States 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.

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

A number of companies are seeking to identify and develop drug candidates for the treatment of CF, including AbbVie, Eloxx Pharmaceuticals, ProQR Therapeutics, Proteostasis Therapeutics, Translate Bio, and several private companies. Our competitors have research and development programs directed at identifying CFTR potentiators, CFTR correctors, ENaC inhibitors and drug candidates with other mechanisms of action or that utilize new therapeutic approaches that seek to address the underlying cause of CF. Our success in rapidly developing and commercializing our CF products may increase the resources that our competitors allocate to the development of these potential treatments for CF. Our competitors are exploring the development of drug candidates both as monotherapies and as part of combination regimens. If one or more competing therapies are successfully developed as a treatment for patients with CF, our products and our CF net product revenues could face competitive pressures. If one or more competing therapies prove to be superior to our then existing products and/or drug candidates for the treatment of CF, our business would be materially adversely affected.

In addition, our business faces competition from major pharmaceutical companies, such as Abbvie, Bristol-Myers Squibb, Gilead, Johnson & Johnson, Merck, Novartis, Pfizer, Sanofi and Roche, which possess substantially greater financial resources than we possess, and 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. As an example of how competition has affected our business in the past, in 2013 and 2014 we experienced a rapid decline in the number of patients being treated with INCIVEK, a product we

previously marketed for the treatment of hepatitis C virus infection, as a result of competition from a treatment regimen identified by a small biotechnology company and developed and commercialized by Gilead.

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 drugs 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 as well as our most advanced drug candidates are related to the treatment of patients with CF. There are many other companies developing drugs for the same indications that we are pursuing. In order 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 drugs.

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. Drugs 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 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 commercial products and our triple combination treatment regimens contain ivacaftor or VX-561, a deuterated version of ivacaftor. As a result, if any of our products or drug candidates were to experience safety issues, our other commercial products as well as one or more of our drug candidates, 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.

In addition, 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 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.

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

Our drugs may not gain or maintain market acceptance among physicians and patients. Effectively marketing our drugs and any of our drug candidates, if approved, requires substantial efforts, both prior to launch and after approval. Physicians may elect not to prescribe our drugs, and patients may elect not to take them or may discontinue use of our drugs 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 drug;
- convenience and ease of administration;
- other potential advantages of alternative treatment methods; and
- ineffective sales, marketing and/or distribution support.

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

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.

Our sales of 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 United States and the national health care systems in many international 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 most ex-U.S. markets, the pricing and reimbursement of therapeutic and other pharmaceutical products is subject to governmental control and such government authorities are increasingly attempting to limit or regulate the price of drug products. In the United States, 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.

Third-party payors throughout the world also have been attempting to control drug spending through various other actions. In reimbursement negotiations, many payers are demanding price discounts and limiting both the types and variety of drugs that they will cover if they are not able to secure them. As part of these negotiations, international government payers also are requiring companies to establish product “cost-effectiveness” as a condition of reimbursement. These cost-effectiveness reviews frequently are subjective, may not account for many of the benefits provided by innovative medicines, and have led to conclusions that certain medicines, including our products in certain jurisdictions, are not worth their price. As a result, certain countries have declined to reimburse some of our products. Although not mandated in the United States, various organizations have started advocating for cost-effectiveness analyses in the United States as well. Notably, if U.S. payors were to adopt such assessments and make corresponding (negative) coverage determinations, we could expect to see a decrease in our future net product revenues, which could harm our business.

There is also an increase in laws, regulations, and activity related to drug pricing and drug pricing transparency. In the United States, various states, including Nevada, Maryland, Louisiana, New York, California, and Oregon, have passed legislation requiring companies to disclose significant amounts of information, including information relating to drug prices, drug price increases, and spending on research, development, and marketing. Although it is not clear what states ultimately will do with the information collected, some laws were designed to obtain additional product discounts, and we likely will continue to see more state action, which could require further disclosures or other actions.

Complying with these laws requires significant personnel and operational resources and deters focus on our business. Additionally, 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.

In addition, in the United States and some foreign jurisdictions, there have been a number of legislative and regulatory proposals and initiatives to change the health care system in ways that could affect our ability to sell products. For example, in the United States, there have been ongoing federal legislative and administrative efforts as well as legal challenges seeking to repeal, substantially modify or invalidate some or all of the provisions of the ACA. Tax legislation enacted at the end of 2017 eliminated the tax penalty for individuals who do not maintain sufficient health insurance coverage beginning in 2019. The Bipartisan Budget Act of 2018 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% starting in 2019. As a result, there is uncertainty regarding future changes in the laws and regulations applicable to the health

care system and the effect any such changes may have on our business. Some of these proposed and implemented reforms have resulted, or could result, in reduced reimbursement rates and/or more limited access for our current or future products, which would adversely affect our business, operations and financial results.

The increasing availability and use of innovative specialty pharmaceuticals, combined with their relative higher cost as compared to other types of pharmaceutical products, is beginning to generate 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 limit the prices that can be charged for our products and may limit our commercial opportunity. The increasing use of health technology assessments in markets around the world and the financial challenges faced by many governments may lead to significant adverse effects on our business.

Any legislation or regulatory changes or relaxation of laws that restrict imports of drugs from other countries, revisions to reimbursement or pharmaceuticals under government programs or general budget control actions also could reduce the net price we receive for our products.

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 federal False Claims Act and the anti-kickback provisions of the federal Social Security Act, laws prohibiting off-label product promotion and other similar laws and regulations both in United States and in non-U.S. markets. While we have a corporate compliance program 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.

The federal anti-kickback law 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. The federal statute has been interpreted to apply to arrangements between pharmaceutical manufacturers on the one hand and prescribers, patients, purchasers and formulary managers on the other hand, and therefore constrains our marketing practices and our various service arrangements with physicians, including physicians who make clinical decisions to use our products. Although there are a number of statutory exemptions and regulatory safe harbors protecting certain common activities from prosecution, the exemptions and safe harbors are drawn narrowly and have been interpreted by courts as such.

Federal false claims laws 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 non-covered 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.

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 CF patients 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 patients represent only a portion of the total patients 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 letter, injunction, seizure, civil fine 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 recent years, legislation has been adopted at the federal, state and local level requiring pharmaceutical companies to establish marketing compliance programs, file periodic reports or make periodic public disclosures on sales, marketing, pricing, clinical trials, health care provider payments and other activities. For example, as part of the ACA,

the federal government enacted the Open Payments (referred to as the Sunshine Act) provisions. Open Payments requires pharmaceutical manufacturers to report annually to the Centers for Medicare and Medicaid Services 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 now have similar reporting obligations

throughout the European Union, or the E.U. We expended significant efforts to establish, and are continuing to devote significant resources to maintain and enhance, systems and processes in order 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 would result in significant civil monetary penalties.

The sales and marketing practices of our industry have been the subject of increased scrutiny from governmental entities in the United Sates and other countries in which we market our products, and we believe that this trend will continue. The risk of our being found in violation of these laws is increased by the fact that many of them have not been fully interpreted by the regulatory authorities or the courts, and their provisions are subject to a variety of interpretations. If our past or present operations are found to be in violation of any such laws or any other governmental regulations that may apply to us, 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. Any action against us for violation of these laws, even if we successfully defend against them, also could cause us to incur significant legal expenses and divert our management's attention from the operation of our business.

There is also enhanced scrutiny of company-sponsored patient assistance programs, including insurance premium and co-pay assistance programs and donations to third party charities that provide such assistance. If we, or our vendors or donation recipients are deemed to fail to comply with relevant laws, regulations or government guidance in the operation of these programs, we could be subject to significant fines and 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 which 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 and a number of other federal and state government pricing programs in the U.S. in order to obtain coverage for the product by certain government health care programs. These programs would generally require us to pay rebates or provide discounts to certain private purchasers or government payers 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. We may also 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. Responding to current and future changes may increase our costs and the complexity of compliance, will be time-consuming, and could have a material adverse effect on our results of operations.

Changes in laws and regulations governing the privacy and protection of data and personal information could adversely affect our business.

We are subject to data privacy and protection laws and regulations that apply to the collection, transmission, storage and use of proprietary information and personally-identifying information, which among other things, impose certain requirements relating to the privacy, security and transmission of individually identifiable health information. 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. Various foreign countries also have, or are developing, laws governing the collection, use, disclosure, security, and cross-border transmission 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 went into effect in May 2018 and has imposed new obligations on us with respect to our processing of personal data and the cross-border transfer of such data. While we continue to address the implications of the recent changes to E.U. 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 and our

efforts to comply with the evolving data protection rules may be unsuccessful. We must devote significant resources to understanding and complying with this changing landscape. Failure to comply with laws regarding data protection would expose us to risk of enforcement actions taken by data protection authorities in the E.U. and the potential for significant penalties if we are found to be non-compliant. Similarly, failure to comply with federal and state laws in the United States regarding privacy and security of personal information could expose us to penalties under such laws. Even if we are not determined to have violated these laws, government investigations into these issues typically require the expenditure of significant resources and generate negative publicity, which could harm our business.

The EMA has adopted a policy on publication of clinical data whereby it will publish clinical reports submitted as part of MAAs for drugs. The EMA aims to publish reports within 60 days after a decision on the application has been made by the European Commission. The ability of third-parties to review and/or analyze the raw data from our clinical trials may increase the risk of patient confidentiality breaches and could result in enhanced scrutiny of our clinical trials results. Such scrutiny could result in misconceptions being spread about our drugs and drug candidates, even if the underlying analysis of such review turns out to be flawed. These publications could also result in the disclosure of information to our competitors that we might otherwise deem confidential, which could harm our competitive position.

The use of social media platforms presents risks and challenges.

Social media is being used by third parties to communicate about our products and drug 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 drug or a drug candidate, which could result in reporting obligations. In addition, our employees may engage on social media in ways that may not comply with our social media policy or 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. If any of these events were to occur or we otherwise fail to comply with applicable regulations, we could incur liability, face restrictive regulatory actions or incur other harm to our business, including damage to our reputation.

Risks Related to Development, Clinical Testing and Regulation of Our Products and Drug Candidates

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

Our business depends upon the successful development and commercialization of drug candidates. These drug 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 drug candidates. Discovery and development efforts for new pharmaceutical products, including new combination therapies, are resource-intensive and may take 10 to 15 years or longer for each drug candidate. Despite our efforts, our drug 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 candidate;
- 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 products.

We have recently completed and/or have ongoing or planned clinical trials for several of our drug candidates. The strength of our company's product portfolio and pipeline will depend in large part upon the outcomes of these clinical trials and our ability to develop and commercialize combination treatments for CF, including our next-generation CFTR corrector compounds and develop treatments for other diseases. 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 drug candidate or program. For example, in 2018 we discontinued development of VX-210 based on a recommendation by the data Safety Monitoring Board, or DSMB, to stop a clinical trial early due to futility.

Moreover, clinical data are often susceptible to varying interpretations, and many companies that have believed their drug candidates performed satisfactorily in clinical trials have nonetheless failed to obtain marketing approval of their

drug 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 drug candidate.

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. Accordingly, the results from completed preclinical studies and clinical trials may not be replicated in later clinical trials, and ongoing clinical trials for our drug candidates may not be predictive of the results we may obtain in later-stage clinical trials or of the likelihood of approval of a drug candidate for commercial sale. In addition, from time to time we report interim data from our clinical trials. Interim data from a clinical trial may not be predictive of final results from the clinical trial.

If we are unable to obtain regulatory approval, we will be unable to commercialize our drug 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 and/or Breakthrough Therapy designation for some of our drug candidates. Drug candidates that receive one or both 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 drug candidates meets the criteria for Fast Track and/or Breakthrough Therapy designation, the FDA may disagree and instead determine not to make such designation. The receipt of one or both of these designations for a drug candidate does not guarantee a faster development process, review or approval compared to drugs 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 drugs or drug candidates qualifies for Fast Track and/or Breakthrough Therapy designation, the FDA may later decide to withdraw such designation if it determines that the drug or drug candidate no longer meets the conditions for qualification.

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

If clinical trials are prolonged or delayed, our development timelines for the affected development program could be extended, our costs to develop the drug candidate could increase and the competitive position of the drug 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;
- 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 inconclusive results, unforeseen complications in testing or clinical investigator error;
- inadequate supply or deficient quality of drug 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 scientific results from clinical trials;
- serious and unexpected drug-related side-effects experienced by participants in our clinical trials or by participants in clinical trials being conducted by our competitors to evaluate drug candidates with similar mechanisms of action or structures to drug candidates that we are developing;
- favorable results in testing of our competitors' drug candidates, or FDA or foreign regulatory authority approval of our competitors' drug 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.

Our ability to enroll patients in our clinical trials in sufficient numbers and on a timely basis is subject to a number of factors, including the size of the patient population, the nature of the protocol, the proximity of patients to clinical sites, the availability of effective treatments for the relevant disease, the number of other clinical trials ongoing and competing for patients in the same indication and the eligibility criteria for the clinical trial. In addition, patients may drop out of our clinical trials or may be lost to follow-up medical evaluation after treatment ends, and this could impair the validity or statistical significance of the trials. Delays in patient enrollment or unforeseen drop-out rates may result in increased costs and longer development times.

We, our collaborators, the FDA or other applicable regulatory authorities may suspend clinical trials of a drug 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 drug candidate and our business.

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 drug candidates.

We have a number of regulated processes and systems that are required both prior to and following approval of our drugs and drug 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 drug 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.

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Risks Related to Collaborations and other Business Development Activities

Our ability to execute on our long-term strategy depends in part on our ability to acquire rights to additional drugs, drug candidates and other technologies that have the potential to add to our pipeline or provide us with new commercial opportunities.

In order to achieve our long-term business objectives, our strategy is to supplement our internal pipeline by acquiring rights to additional drugs, drug candidates and other technologies that have the potential to provide us with new commercial opportunities, including in CF and in therapeutic areas outside of CF. We may not be able to acquire, in-license or otherwise obtain rights to additional drugs, drug candidates or other technologies on acceptable terms or at all. We have faced and will continue to face significant competition for the acquisition of rights to these types of drugs, drug candidates and other technologies from a variety of other companies with interests in the specialty pharmaceutical marketplace, many 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 drugs, drug candidates or technologies, which may provide incentives for companies to advance these drugs, drug candidates or technologies independently. Because of these competitive pressures, the cost of acquiring, in-licensing or otherwise obtaining rights to such drugs, drug 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. This competition is most intense for approved drugs and late-stage drug candidates, which have the lowest risk and would have the most immediate effect on our financial performance.

We may not realize the anticipated benefits of potential acquisitions or licenses to businesses, drugs, drug candidates and other technologies, and the integration following any such acquisition or license may disrupt our business and management.

We may acquire a business or the rights to drugs, drug candidates or other technologies. In recent years we have entered into both acquisition and collaboration arrangements, including our acquisition of VX-561 from Concert, our agreement with 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 and our collaboration agreement with Moderna, pursuant to which we are seeking to identify and develop mRNA therapeutics for the treatment of CF. With respect to each of these transactions and any additional acquisition of a business or rights to drugs, drug candidates or other technologies, we may not realize the anticipated benefits of such transaction, each of which involves numerous risks. These risks include:

- failure to successfully develop and commercialize the drugs, drug candidates or technologies that we acquire or license or to achieve other strategic objectives;
- inadequate or unfavorable data from clinical trials evaluating the acquired or licensed drug or drug candidates;
- entry into markets in which we have no or limited direct prior experience or where competitors in such markets have stronger market positions;
- disruption of our ongoing business and distraction of our management and employees from other opportunities and challenges;
- potential failure of the due diligence processes to identify significant problems, liabilities or other shortcomings or challenges of an acquired company, or acquired or licensed drug, drug candidate or technology, including but not limited to, problems, liabilities or other shortcomings or challenges with respect to intellectual property, product quality, safety, accounting practices, employee, customer 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;
- difficulty in integrating the drugs, drug candidates, technologies, business operations and personnel of an acquired asset or company; 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 and licensing arrangements are inherently risky, and ultimately, if we do not complete an announced acquisition or license transaction or integrate an acquired business, or an acquired or licensed drug, drug candidate or other technology successfully and in a timely manner, we may not realize the benefits of the acquisition or license to the extent anticipated and the perception of the effectiveness of our management team and our company may suffer in the marketplace. Additionally, we may later incur impairment charges related to assets acquired in any such transaction. For example, we entered into a strategic collaboration and license agreement with Parion Sciences, Inc., or Parion, to develop ENaC inhibitors in 2015 and incurred an impairment charge related to this collaboration in the third quarter of 2017. In addition, even if we achieve the long-term benefits associated with strategic transactions, our expenses and short-term costs may increase materially and adversely affect our liquidity and short-term net income (loss). Future licenses or acquisitions could result in potentially dilutive issuances of equity securities, the incurrence of debt, the creation of contingent liabilities, impairment expenses related to goodwill, and impairment or amortization expenses related to other intangible assets, 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 drug candidates.

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

- Our collaborators may change the focus of their development and commercialization efforts or may have insufficient resources to effectively develop our drug candidates. The ability of some of our products and drug candidates to reach their potential could be limited if collaborators decrease or fail to increase development or commercialization efforts related to those products or drug candidates. Our collaboration agreements 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.
- Any future 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 drugs or drug 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 drug candidates, might lead to additional responsibilities for us with respect to drug candidates, or might result in litigation or arbitration. Any such disagreements would divert management attention and resources and 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.

Additionally, if a collaborator were to be involved in a business combination, it might deemphasize or terminate the development or commercialization of any drug 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 drug 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 early-stage clinical development programs, some of which are being developed in collaboration with a third party. For example, we have an ongoing collaboration with Janssen, pursuant to which Janssen is developing drug candidates that resulted from our research activities. At any time, we may determine that in order to continue development of a drug 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 or similar regulatory authorities outside the United States, the potential market for the subject drug candidate, the costs and complexities of manufacturing and delivering such drug 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 Third-Party Manufacturing and Reliance on Third Parties

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

We rely on a worldwide network of third-party manufacturers to manufacture our drugs for commercial use and our drug candidates for clinical trials. As a result of our reliance on these third-party manufacturers and suppliers, we could be subject to significant supply disruptions outside of our control. Our supply chain for sourcing raw materials and manufacturing drug product ready for distribution 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. Establishing and managing this global supply chain requires a significant financial commitment and the creation and maintenance of numerous third-party contractual relationships. Although we attempt to manage the business relationships with companies in our supply chain, we do not have control over their operations. 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 or any other performance failure by any third-party manufacturer on which we rely. Any supply disruptions could disrupt sales of our products and/or the timing of our clinical trials.

We require a supply for our medicines for commercial sale and a supply of our drug candidates for use in our clinical trials. While we have developed some internal capabilities, a majority of the manufacturing steps needed to produce our drug candidates and drug products are performed through a third-party manufacturing network. To ensure the stability of our supply chains we aim to develop additional sources of manufacture for all steps of our manufacturing processes at the time of, or shortly after, marketing approval. Therefore, at any point in time, we may have a limited number of single source manufacturers for certain steps in our manufacturing processes, particularly for recently launched products.

If we or our third-party manufacturers become unable or unwilling to continue manufacturing product on our behalf 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 drug products could delay the completion of clinical trials and affect timelines for regulatory filings. There can be no assurance that we will be able to establish and maintain secondary manufacturers for all of our drug candidates and drug 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 drug 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 in order to have our products or drug candidates manufactured by other suppliers utilizing the same process.

We rely on third parties to conduct certain pre-clinical work and clinical trials, 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 contract research organizations 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 CFF, to assist in the design and review of, and to conduct our clinical trials, including enrolling qualified patients. 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. 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 these activities, it may result in a delay of the affected clinical trial or drug development program. 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 drug candidates could be delayed.

Risks Related to Intellectual Property

If our patents do not protect our drugs or our drugs 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 have numerous issued patents and pending patent applications in the United States, 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 drugs, 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 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, or the Leahy-Smith Act, includes a number of significant changes to United States patent law. These include provisions that affect the way patent applications are prosecuted and may also affect patent litigation. The United States Patent Office developed new regulations and procedures to govern administration of the Leahy-Smith Act, and many of the substantive changes to patent law associated with the Leahy-Smith Act, and in particular, the first to file provisions, became effective in March 2013. 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 drug candidates or their use. If a third party also has filed a U.S. patent application relating to our drugs or drug 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 Lahey-Smith Act, if a third-party has an earlier filed U.S. patent application relating to our drugs or drug 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, resulting 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 might not contain claims that are sufficiently broad to prevent others from utilizing our technologies. For instance, the issued patents relating to our drugs or drug candidates may be limited to a particular molecule or molecules and may not cover similar molecules that have similar clinical properties. Consequently, our competitors may

independently develop competing products that do not infringe our patents or other intellectual property. In addition, if the breadth or strength of protection provided by our patents and patent applications is threatened, it could dissuade companies from collaborating with us to license, develop or commercialize current or future products.

The laws of many foreign jurisdictions do not protect intellectual property rights to the same extent as in the United States 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 drug candidates, it is possible that a patent may expire before a drug candidate can be commercialized, or a patent may expire or remain in effect for only a short period following commercialization of such drug candidate. This would result in a minimal or non-existent period of patent exclusivity. If our drug candidates are not commercialized significantly ahead of the expiration date of any applicable patent, or if we have no patent protection on such drug candidates, then, to the extent available we would rely on other forms of exclusivity, such as regulatory exclusivity provided by the FDCA and its counterpart agencies in various jurisdictions, and/or orphan drug exclusivity.

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

There is considerable uncertainty within our industry about the validity, scope and enforceability of many issued patents in the United States 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 drugs or to remove our drugs from the market. Any litigation, including litigation related to Abbreviated New Drug Applications, or 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 financial statements.

To the extent that valid present or future third-party patents or other intellectual property rights cover our drugs, drug candidates or technologies, we or our strategic collaborators may seek licenses or other agreements from the holders of such rights in order 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 drugs. 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

Risks associated with operating in foreign countries could materially adversely affect our business.

We have expanded our international operations over the past several years in order 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 as well as patient-level clinical trial data. New laws in the E.U. also have expanded protections related to personal data and provided for increased sanctions for violations. Collectively, our expansion and these new requirements are adding to our compliance costs and expose us to potential sanctions for failing to meet the enhanced safeguards and reporting demands 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. 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 conducting operations in foreign countries 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;
- collectibility 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 are interpreted and enforced differently across jurisdictions and 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 United States;
- import and export licensing requirements, tariffs, and other trade and travel restrictions;
- 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 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 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.

Risk relating to the Referendum of the United Kingdom's Membership of the European Union.

Our European headquarters and European research facility are located in the United Kingdom, or the U.K., and a significant portion of our ex-U.S. net product revenues are derived from sales in the U.K. In June 2016, the U.K. held a referendum in which voters approved an exit from the E.U., commonly referred to as "Brexit." The U.K. government provided official notice of withdrawal from the E.U. in March 2017 and has a period of two years from the date of its formal notification (such period ending March 29, 2019) to negotiate the terms of its withdrawal from, and future relationship with, the E.U., including the terms of trade between the U.K. and the E.U. and potentially other countries. If no formal withdrawal agreement is reached, then it is expected that the U.K.'s membership in the E.U. will automatically terminate two years after the submission of the notification of the U.K.'s intention to withdraw from the E.U., unless all remaining member states unanimously consent to an extension of this period. Discussions between the U.K. and the E.U. focused on finalizing withdrawal issues and transition agreements are ongoing. However, limited progress to date in these negotiations and ongoing uncertainty within the U.K. government increases the possibility of the U.K. leaving the E.U. on March 29, 2019 without a withdrawal agreement and associated transition period in place, which is likely to cause significant market and economic disruption, which may cause third-party payors, including governmental organizations, to closely monitor their costs and reduce their spending budgets. The effects of Brexit will depend on any agreements the U.K. makes to retain access to E.U. markets either during a transitional period or more permanently. Brexit could lead to legal uncertainty and potentially divergent national laws and regulations as the U.K. determines which E.U. laws to replace or replicate. Given the lack of comparable precedent, it is unclear what financial, trade, regulatory and legal implications the withdrawal of the U.K. from the E.U. would have and how such withdrawal would affect us. Any of these effects of Brexit, among others, could adversely affect our business, financial condition and operating results.

Our business has a substantial risk of product liability claims and other litigation liability. If we do not obtain appropriate levels of insurance, any potential claims could adversely affect our business.

We are or may be involved in various legal proceedings, including securities class action lawsuits and claims related to product liability, intellectual property and breach of contract. Such proceedings may involve claims for, or the possibility of, 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 drug 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.

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. The size and complexity of our information technology and information security systems makes such systems potentially vulnerable to service interruptions or to security breaches. 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 in an attempt 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, cyber-attacks are increasing in their frequency, sophistication and intensity, and have become increasingly difficult to detect. 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.

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

Because our drug discovery and development activities are highly technical in nature, 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 marketing and commercialization of medicines. We have entered into employment agreements with some executives and provide compensation-related 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 — such as options and restricted stock units — is significantly affected by movements in our stock price, 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. 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 have increased competition for the available pool of skilled employees, especially in technical fields, and the high cost of living in Massachusetts makes it difficult to attract employees from other parts of the country to Massachusetts. 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 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.

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.

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 would have a material adverse effect on our business.

Risks Related to Holding Our Common Stock

Our stock price may fluctuate.

Market prices for securities of companies such as ours are highly volatile. From January 1, 2018 to December 31, 2018, our common stock traded between $144.07 and $194.92 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 our net product revenues and operating expenses for completed periods and guidance regarding future periods;
- announcements of FDA actions with respect to our drugs or our competitors' drugs, or regulatory filings for our drug candidates or those of our competitors, or announcements of interim or final results of clinical trials or nonclinical studies relating to our drugs, drug candidates or those of our competitors;
- developments in domestic and international governmental policy or regulation, for example, relating to drug pricing or intellectual property rights;
- 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.

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 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 level 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 related to business development activities, changes in the fair value of our strategic investments, impairment charges, charges for excess and obsolete inventories, changes in the fair value of derivative

instruments and the consolidation or deconsolidation of variable interest entities. 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 drug candidates or competitive products or potentially competitive drug 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 drug candidates, competitive products or potentially competitive drug 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.

Changes in tax laws, regulations and treaties could affect our future taxable income.

A change in tax laws, treaties or regulations, or their interpretation, of any country in which we operate could materially affect us if we generate taxable income in a future period. On December 22, 2017, the United States enacted H.R.1., known as the Tax Cuts and Jobs Act, which represented a substantial change to tax laws in the United States, but which did not have a material impact on our financial statements because we maintained a valuation allowance on the majority of our net operating losses and other deferred tax assets as of December 31, 2017, which was only released at the end of 2018. However, over the next several years we expect to utilize our net operating losses and other deferred assets, and any future changes in tax laws could have a material effect on our business. We continue to assess the impact of various tax reform proposals and modifications to existing tax treaties in all jurisdictions where we have operations to determine the potential effect on our business and any assumptions we have made about our future taxable income. We cannot predict whether any specific proposals will be enacted, the terms of any such proposals or what effect, if any, such proposals would have on our business if they were to be enacted.

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. Additionally, our pledge of specified assets as collateral to secure our obligations under our credit agreement may limit our ability to obtain additional debt financing. 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, drugs or drug 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 agreement impose restrictions on our business, reducing our operational flexibility and creating default risks.

In October 2016, we entered into a credit agreement providing for a $500 million revolving facility, $300 million of which was drawn at closing and subsequently paid off in February 2017. The credit agreement provides that, subject to the

satisfaction of certain conditions, we may request that the borrowing capacity under the credit agreement be increased by an additional $300.0 million. All outstanding borrowings under the credit agreement mature on October 13, 2021. If we borrow under our current credit agreements or any future credit agreement, 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 (i) a consolidated leverage ratio covenant and (ii) a consolidated EBITDA covenant, in each case to be measured on a quarterly basis. 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, pay dividends, repurchase capital stock 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 owing under the credit agreement and/or our capital 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. All obligations under the credit agreement, and the guarantees of those obligations, are secured by substantially all of our assets and the assets of all guarantors (excluding intellectual property, owned and leased real property and certain other excluded property), including the pledge of all or a portion of the equity interests of certain of our subsidiaries. If we fail to satisfy our obligations under the credit agreement or are unable to obtain sufficient funds to make payments, the lenders could foreclose on our pledged collateral.

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

As of December 31, 2018, we had 255.2 million shares of common stock issued and outstanding. As of December 31, 2018, we also had outstanding options to purchase 8.6 million shares of common stock with a weighted-average exercise price of $111.46 per share. Outstanding vested options are likely to be exercised if the market price of our common stock exceeds the applicable exercise price, and, in the future, we expect to issue additional options and restricted stock units to directors and employees. 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.

Our Board of Directors has authorized a share repurchase program of up to $500 million to repurchase shares 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 anti-takeover provisions and are subject to Massachusetts corporate laws that may frustrate any attempt to remove or replace our current management or effectuate a business combination involving Vertex.

Our corporate charter and by-law provisions and Massachusetts state laws may discourage certain types of transactions involving an actual or potential change of control of Vertex that might be beneficial to us or our security holders. Although we amended our charter to eliminate staggered terms for our Board of Directors, our shareholders will not have the ability to vote for all members of the Board of Directors on an annual basis until 2020. Our by-laws grant the directors a right to adjourn annual meetings of shareholders, and certain provisions of our by-laws may be amended only with an 80% shareholder vote. 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 prohibits us from engaging in specified business combinations, unless the combination is approved or consummated in a prescribed manner, and prohibits voting by any shareholder who acquires 20% or more of our voting stock without shareholder approval. As a

result, shareholders or other parties may find it more difficult to remove or replace our current management.

SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K and, in particular, the description of our Business set forth in Item 1, the Risk Factors set forth in this Item 1A and our Management's Discussion and Analysis of Financial Condition and Results of Operations set forth in Item 7 contain or incorporate a number of forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended, including statements regarding:

- our expectations regarding the amount of, timing of and trends with respect to our revenues, costs and expenses and other gains and losses, including those related to our CF net product revenues;
- our expectations regarding clinical trials, development timelines and regulatory authority filings and submissions for ivacaftor, lumacaftor, tezacaftor, VX-659, VX-445, VX-150 and the timelines for regulatory filings for a triple combination regimen;
- our ability to obtain reimbursement for our medicines in ex-U.S. markets and our ability to otherwise successfully market our medicines or any drug candidates for which we obtain regulatory approval;
- our expectations regarding the timing and structure of clinical trials of our drugs and drug candidates and the expected timing of our receipt of data from our ongoing and planned clinical trials;
- 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 drug candidates for further investigation, clinical trials or potential use as a treatment;
- our plan to continue investing in our research and development programs and our strategy to develop our drug candidates, alone or with third party-collaborators;
- the establishment, development and maintenance of collaborative relationships;
- potential business development activities;
- potential fluctuations in foreign currency exchange rates;
- our ability to use our research programs to identify and develop new drug candidates to address serious diseases and significant unmet medical needs; and
- our liquidity and our expectations regarding the possibility of raising additional capital.

Any or all of our forward-looking statements in this Annual Report on Form 10-K may turn out to be wrong. They can be affected by inaccurate assumptions or by known or unknown risks and uncertainties. Many factors mentioned in this Annual Report on Form 10-K will be important in determining future results. Consequently, no forward-looking statement can be guaranteed. Actual future results may vary materially from expected results. We also provide a cautionary discussion of risks and uncertainties under "Risk Factors" above in this Item 1A. These are factors and uncertainties that we think could cause our actual results to differ materially from expected results. Other factors and uncertainties besides those listed there could also adversely affect us.

Without limiting the foregoing, the words "believes," "anticipates," "plans," "intends," "expects" and similar expressions are intended to identify forward-looking statements. There are a number of factors and uncertainties that could cause actual events or results to differ materially from those indicated by such forward-looking statements, many of which are beyond our control, including the factors and uncertainties set forth under "Risk Factors" above in this Item 1A. In addition, the forward-looking statements contained herein represent our estimate only as of the date of this filing and should not be relied upon as representing our estimate as of any subsequent date. While we may elect to update these forward-looking statements at some point in the future, we specifically disclaim any obligation to do so to reflect actual results, changes in assumptions or changes in other factors affecting such forward-looking 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, 2018 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. The leases commenced in December 2013 and will extend until December 2028. We have an option to extend the term of the leases for an additional ten years. In addition, we have a lease for approximately 100,000 square feet of space in the Boston Marine Industrial Park, in close proximity to our corporate headquarters. We are using this additional space for certain logistical and laboratory operations and manufacturing equipment that complement the office and laboratory facilities at our corporate headquarters.

Additional United States and Worldwide Locations

In addition to our facilities in Massachusetts, we lease an aggregate of approximately 300,000 square feet of space. We lease approximately 170,000 square feet of office and laboratory space in San Diego, California to a lease that expires in 2035. Our other facilities include laboratory and office space to support our research and development organizations Milton Park, Abingdon, England, and office space in many of the countries in which we sell our products.

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, 2019, there were 1,277 holders of record of our common stock.

Performance Graph

We became part of the Standard & Poor's 500 ("S&P 500®") Stock Index in 2013.

Dividends

We currently expect that any future earnings will be retained for use in our business. Any future determination to declare cash dividends will be subject to the discretion of our board of directors and applicable law and will depend on various factors, including our results of operations, financial condition, prospects and any other factors deemed relevant by our board of directors. In addition, our credit agreement limits our ability to pay cash dividends on our common stock.

Issuer Repurchases of Equity Securities

We have a share repurchase program, announced in January 2018, under which we are authorized to repurchase up to $500.0 million of our common stock by December 31, 2019. As of September 30, 2018, we had repurchased $211.0 million of common stock under this program and had remaining available $289.0 million to repurchase additional shares under this program. The table set forth below shows repurchases of securities by us during the three months ended December 31, 2018, including shares repurchased under our share repurchase program and a small number of restricted shares repurchased by us from employees pursuant to our equity programs. As of December 31, 2018, we had repurchased $350.0 million of common stock under the share repurchase program and had remaining available $150.0 million to repurchase additional shares pursuant to this program.

Period	Total Number of Shares Purchased (1)	Average Price Paid per Share	Total Number of Shares Purchased as Part of Publicly Announced Plans or Programs (2)	Maximum Number of Shares (or approximate dollar amount) that May Yet be Purchased Under the Plans or Programs (2)
Oct. 1, 2018 to Oct. 31, 2018	278,920	$174.24	275,351	$240,390,554
Nov. 1, 2018 to Nov. 30, 2018	346,159	$165.80	338,979	$182,995,963
Dec. 1, 2018 to Dec. 31, 2018	197,930	$166.70	196,878	$150,000,059
Total	823,009	$168.88	811,208	$150,000,059

(1) Consists of 811,208 shares repurchased pursuant to our share repurchase program (described in footnote 2 below) at an average price of $171.33 per share and 11,801 restricted shares repurchased for $0.01 per share from our employees pursuant to our equity plans. While we have restricted shares that are continuing to vest under our equity plans that are subject to repurchase rights upon termination of service, we have transitioned our equity program to granting restricted stock units. Unvested restricted stock units are forfeited upon termination of service and do not result in an issuer repurchase that would be reflected in this table.

(2) Our board of directors has approved a share repurchase program pursuant to which we are authorized to repurchase up to $500.0 million of our common stock by December 31, 2019; the program was announced on January 31, 2018. Under the share repurchase program, we are authorized to purchase shares from time to time through open market or privately negotiated transactions and such purchases may be made pursuant to Rule 10b5-1 plans or other means as determined by our management and in accordance with the requirements of the Securities and Exchange Commission. The approximate dollar value of shares that may yet be repurchased is based solely on shares that may be repurchased under the share repurchase program and excludes any shares that may be repurchased under our employee equity programs.

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ITEM 6. SELECTED FINANCIAL DATA

The following unaudited selected consolidated financial data are derived from our audited consolidated financial statements. These data should be read in conjunction with our audited consolidated financial statements and related notes that are included elsewhere in this Annual Report on Form 10-K and with "Management's Discussion and Analysis of Financial Condition and Results of Operations" included in Item 7.

	Year Ended December 31,				
	2018	2017	2016	2015	2014
Consolidated Statements of Operations Data:	(in thousands, except per share amounts)				
Product revenues, net	$3,038,325	$2,165,480	$1,683,632	$1,000,324	$487,821
Collaborative and royalty revenues (1)	9,272	323,172	18,545	32,012	92,594
Total revenues	3,047,597	2,488,652	1,702,177	1,032,336	580,415
Total costs and expenses (2)	2,412,447	2,365,409	1,692,241	1,499,215	1,272,827
(Benefit from) provision for income taxes (3)	(1,486,862)	(107,324)	16,665	30,381	6,958
Net income (loss) attributable to Vertex	$2,096,896	$263,484	$(112,052)	$(556,334)	$(738,555)
Diluted income (loss) from continuing operations per share attributable to Vertex common shareholders	$8.09	$1.04	$(0.46)	$(2.31)	$(3.14)
Shares used in per diluted share calculations	259,185	253,225	244,685	241,312	235,307

	As of December 31,				
	2018	2017	2016	2015	2014
Consolidated Balance Sheet Data:	(in thousands)				
Cash, cash equivalents and marketable securities	$3,168,242	$2,088,666	$1,434,557	$1,042,462	$1,387,106
Deferred tax assets (3)	1,499,672	—	—	—	—
Total assets	6,245,898	3,546,014	2,896,787	2,498,587	2,334,679
Total current liabilities (4)	1,120,292	807,260	792,537	506,167	368,254
Long-term debt obligations, excluding current portion	—	—	—	223,863	280,569
Construction financing lease obligation, excluding current portion (5)	561,892	563,406	486,359	472,611	473,073
Other long-term obligations	128,511	133,042	279,700	202,318	116,600

(1) In 2017, we recorded $230.0 million of collaborative and royalty revenues related to an upfront payment made to us pursuant to our collaboration agreement with Merck KGaA, Darmstadt, Germany. See Note B, "Collaborative Arrangements and Acquisitions."

(2) Total costs and expenses included (i) in 2018 and 2017, intangible asset impairment charges of $29.0 million and $255.3 million, respectively, (ii) $111.9 million collaborative expenses in 2018 primarily related to strategic license agreements; $168.7 million collaborative expenses in 2017 primarily related to an asset acquisition and (iii) in 2014, $50.9 million of restructuring charges primarily related to the relocation of our corporate headquarters. See Note J, "Intangible Assets and Goodwill," and Note B, "Collaborative Arrangements and Acquisitions."

(3) In 2018, we released the valuation allowance on the majority of our net operating losses and other deferred tax assets resulting in a benefit from income taxes of $1.56 billion in the fourth quarter of 2018 and we recorded a $1.50 billion deferred tax asset on our consolidated balance sheet as of December 31, 2018. In 2018 and 2017, we recorded benefits from income taxes related to the impairment of intangible assets. See Note J, "Intangible Assets and Goodwill."

(4) As of December 31, 2018 and 2017, we had $354.4 million and $232.4 million, respectively, recorded as current liabilities related to cash received by us for sales of ORKAMBI in France for which the price has not been established. See Note A, "Nature of Business and Accounting Policies."

(5) We have entered into several leases in which we are deemed to be the owner for accounting purposes. See Note L, "Long-term Obligations."

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

OVERVIEW

We invest in scientific innovation to create transformative medicines for people with serious diseases. Our business is focused on developing and commercializing therapies for the treatment of cystic fibrosis, or CF, and advancing our research and development programs in other serious diseases. Our marketed products are SYMDEKO/SYMKEVI (tezacaftor in combination with ivacaftor), ORKAMBI (lumacaftor in combination with ivacaftor) and KALYDECO (ivacaftor), which are collectively approved to treat approximately half of the 75,000 CF patients in North America, Europe and Australia. Our triple combination regimens, if approved, would significantly increase the number of CF patients eligible for our products and could provide an improved treatment option for a majority of the patients currently eligible for our products. In November 2018, we reported positive data, including interim data, from the Phase 3 clinical trials evaluating the triple combination of VX-659, tezacaftor and ivacaftor in patients with a copy of the F508del mutation in their CFTR gene and a second mutation that results in minimal CFTR function, whom we refer to as F508del/Min patients; and who have two copies of the F508del mutation, whom we refer to as F508del homozygous patients. In the first quarter of 2019, we expect to report data from the Phase 3 clinical trials evaluating the triple combination of VX-445, tezacaftor and ivacaftor. We expect that this data in conjunction with the VX-659 data that was reported in November 2018 will enable us to choose the better of the two regimens to submit for regulatory approval. We expect to submit a New Drug Application, or NDA, to the United States Food and Drug Administration, or FDA, for a triple combination regimen no later than mid-2019. We also are developing drug candidates for the treatment of pain, beta-thalassemia, sickle cell disease and alpha-1 antitrypsin deficiency.

2018 Financial Highlights

Revenues:

In 2018, our CF net product revenues continued to increase due to the approval of our third CF medicine, SYMDEKO/SYMKEVI, and increasing KAYLDECO net product revenues. In 2019, we expect our CF net product revenues to continue to increase due to full-year revenues from SYMDEKO/SYMKEVI and further CF net product revenue growth will be dependent on if, and when, we are able to able to obtain approval to market a triple combination regimen for patients with CF.

Expenses

In 2018, combined R&D and SG&A expenses increased by 8% from $1.82 billion in 2017 to $1.97 billion in 2018. In 2018, cost of sales was approximately 13.5% of our CF net product revenues.

Balance Sheet

Increased balance sheet strength driven by earnings.

2018 Business Highlights

Cystic Fibrosis

- Announced positive data from two Phase 3 clinical trials evaluating the triple combination of VX-659, tezacaftor and ivacaftor in F508del/Min patients and F508del homozygous patients 12 years of age or older.

- Completed enrollment in two Phase 3 clinical trials evaluating the triple combination of VX-445, tezacaftor and ivacaftor in F508del/Min patients and F508del homozygous patients 12 years of age or older. Data from these clinical trials is expected in the first quarter of 2019.

- Obtained approval for SYMDEKO in the United States in the first quarter of 2018 for F508del homozygous patients 12 years of age or older.
- Successfully launched SYMDEKO in the United States.
- Obtained approval for SYMKEVI in the European Union in the fourth quarter of 2018 for F508del homozygous patients 12 years of age or older.

- Obtained approvals from the FDA and EMA for label expansions for KALYDECO and ORKAMBI for younger patient groups.
- Entered into innovative long-term access agreements in ex-U.S markets, including Australia and Denmark.
- Initiated a Phase 1 clinical trial to evaluate VX-121, an additional next-generation CFTR corrector.

Expanding Pipeline

- Demonstrated proof-of-concept for VX-150, a NaV1.8 inhibitor, in acute and neuropathic pain and initiated a Phase 2b dosing ranging clinical trial.
- Initiated first clinical trials of CTX001, an investigational gene-editing treatment that we are evaluating as a potential treatment for beta-thalassemia and sickle cell disease.

- Initiated a Phase 1 clinical trial for a novel drug candidate for alpha-1 antitrypsin deficiency.
- Established a collaboration with Arbor Biotechnologies to enhance our ongoing efforts to develop innovative gene-editing therapies for a range of serious diseases.

Research

We plan to continue investing in our research programs and fostering scientific innovation in order to identify and develop transformative medicines. In addition to continuing our research in CF, our current research programs include programs targeting pain, alpha-1 antitrypsin and focal segmental glomerulosclerosis. We believe that pursuing research in diverse areas allows us to balance the risks inherent in drug development and may provide drug candidates that will form our pipeline in future years. To supplement our internal research programs, we 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.

Drug Discovery and Development

Discovery and development of a new pharmaceutical product is a difficult and lengthy process that requires significant financial resources along with extensive technical and regulatory expertise. Potential drug candidates are subjected to rigorous evaluations, driven in part by stringent regulatory considerations, designed to generate information concerning efficacy, side-effects, proper dosage levels and a variety of other physical and chemical characteristics that are important in determining whether a drug candidate should be approved for marketing as a pharmaceutical product. Most chemical compounds that are investigated as potential drug candidates never progress into development, and most drug candidates that do advance into development never receive marketing approval. Because our investments in drug candidates are subject to considerable risks, we closely monitor the results of our discovery, research, clinical trials and nonclinical studies and frequently evaluate our drug 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 abrupt 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. If we believe that data from a completed registration program support approval of a drug candidate, we submit an NDA to the FDA requesting approval to market the drug candidate in the United States and seek analogous approvals from comparable regulatory authorities in jurisdictions outside the United States. To obtain approval, we must, among other things, demonstrate with evidence gathered in nonclinical studies and well-controlled clinical trials that the drug candidate is safe and effective for the disease it is intended to treat and that the manufacturing facilities, processes and controls for the manufacture of the drug candidate are adequate. The FDA and ex-U.S. regulatory authorities have substantial discretion in deciding whether or not a drug candidate should be granted approval based on the benefits and risks of the drug candidate in the treatment of a particular disease, and could delay, limit or deny regulatory

approval. If regulatory delays are significant or regulatory approval is limited or denied altogether, our financial results and the commercial prospects for the drug candidate involved will be harmed.

Regulatory Compliance

Our marketing of pharmaceutical products is subject to extensive and complex laws and regulations. We have a corporate compliance program designed to actively identify, prevent and mitigate risk through the implementation of compliance policies and systems and through the promotion of a culture of compliance. Among other laws, regulations and standards, we are subject to various U.S. federal and state laws, and comparable laws in other jurisdictions, pertaining to health care fraud and abuse, including anti-kickback and false claims laws, and laws prohibiting the promotion of drugs for unapproved or off-label uses. Anti-kickback laws make it illegal for a prescription drug manufacturer to solicit, offer, receive or pay any remuneration to induce the referral of business, including the purchase or prescription of a particular drug that is reimbursed by a state or federal program. False claims laws prohibit anyone from knowingly or willfully presenting for payment to third-party payors, including Medicare and Medicaid, 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. We are subject to laws and regulations that regulate the sales and marketing practices of pharmaceutical manufacturers, as well as laws such as the U.S. Foreign Corrupt Practices Act, which govern our international business practices with respect to payments to government officials. We expect to continue to devote substantial resources to maintain, administer and expand these compliance programs globally.

Reimbursement

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

In the United States, we have worked successfully with third party-payors in order to promptly obtain appropriate levels of reimbursement for our CF medicines, and as such, more than 95% of patients across the U.S. have access to our medicines through their insurance plans. We 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 by treating the underlying cause of cystic fibrosis and continue to provide access to our current medicines.

In Europe and other ex-U.S. markets, we seek government reimbursement for our medicines on a country-by-country basis. This is necessary for each new medicine, as well as label expansions for our current medicines in most countries. We successfully obtained reimbursement for KALYDECO in each significant ex-U.S. market within two years of approval. We are experiencing significant challenges in obtaining reimbursement for ORKAMBI in certain ex-U.S. markets. Specifically, we have been discussing potential reimbursement for ORKAMBI in the United Kingdom and France, which represent significant potential markets for our CF medicines, since its approval in 2015. In other ex-U.S. markets, including Australia, Denmark, Germany, Ireland, Sweden and Italy, we have reached pricing and reimbursement agreements for ORKAMBI. In some of these countries, we have innovative reimbursement arrangements that provide a pathway to access and rapid reimbursement for certain future CF medicines, including arrangements in Ireland, Denmark and Australia.

Collaboration Arrangements and Strategic Investments

In-License Agreements

We have entered into collaborations with biotechnology and pharmaceutical companies in order to acquire rights or to license drug candidates or technologies that enhance our pipeline and/or our research capabilities. Over the last several years, we entered into collaboration agreements with:

- CRISPR Therapeutics AG, or CRISPR, pursuant to which we are collaborating on the discovery and development of potential new treatments aimed at the underlying genetic causes of human diseases using CRISPR-Cas9 gene editing technology;
- Arbor Biotechnologies, Inc., or Arbor, pursuant to which we are collaborating on the discovery of novel proteins, including DNA endonucleases, to advance the development of new gene-editing therapies; and
-

Moderna Therapeutics, Inc., or Moderna, pursuant to which we are seeking to identify and develop messenger ribonucleic acid, or mRNA, therapeutics for the treatment of CF.

Generally, when we in-license a technology or drug candidate, we make upfront payments to the collaborator, assume the costs of the program and agree to make contingent payments, which could consist of milestone, royalty and option payments. Depending on many factors, including the structure of the collaboration, the significance of the drug candidate that we license

to the collaborator's operations and the other activities in which our collaborators are engaged, the accounting for these transactions can vary significantly.

For example, the upfront payments and expenses incurred in connection with our CRISPR and Moderna collaborations are being expensed as research expenses because the collaboration represents a small portion of each of these collaborator's overall business. CRISPR and Moderna's activities unrelated to our collaborations have no effect on our consolidated financial statements. In contrast, Parion Sciences, Inc., or Parion, and BioAxone Biosciences, Inc., or BioAxone, have historically been accounted for as variable interest entities, or VIEs, and historically have been included in our consolidated financial statements due to (i) the significance of the respective licensed programs to Parion and BioAxone as a whole, (ii) our power to control the significant activities of the entities under each collaboration and (iii) our obligation to absorb losses and right to receive benefits that potentially could be significant. In 2017 and 2018, we determined that the above conditions were no longer satisfied with respect to Parion and BioAxone, respectively. As a result, we deconsolidated Parion and BioAxone from our consolidated financial statements as of September 30, 2017 and December 31, 2018, respectively.

A collaborator that we account for as a VIE may engage in activities unrelated to our collaboration. The revenues and expenses unrelated to the programs we in-license from our VIEs have historically been immaterial to our consolidated financial statements. With respect to each of Parion and BioAxone, the activities unrelated to our collaborations with these entities represented approximately 2% or less of our total revenues and total expenses on an annual basis during the periods that we consolidated these collaborators. As a result of these deconsolidations, these amounts decreased in 2018 compared to 2017 and we do not expect to have similar items in 2019 based on our current collaborations. For consolidated VIEs, we evaluated the fair value of the contingent payments payable by us on a quarterly basis. Changes in the fair value of these contingent future payments affected net income attributable to Vertex on a dollar-for-dollar basis, with increases in the fair value of contingent payments payable by us to a VIE resulting in a decrease in net income attributable to Vertex (or an increase in net loss attributable to Vertex) and decreases in the fair value of contingent payments payable by us to a VIE resulting in an increase in net income attributable to Vertex (or decrease in net loss attributable to Vertex). For additional information regarding our VIEs see Note B, "Collaborative Arrangements and Acquisitions," and our critical accounting policies "Collaborations; Intangible Assets and Variable Interest Entities."

Out-License Agreements

We also have out-licensed internally-developed programs to collaborators who are leading the development of these programs. These out-license arrangements include our collaboration agreements with:

- Janssen Pharmaceuticals, Inc., or Janssen, which is evaluating pimodivir in Phase 3 clinical trials for the treatment of influenza; and
- Merck KGaA, Darmstadt, Germany, which licensed oncology research and development programs from us in early 2017.

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.

Strategic Investments

In connection with our business development activities, we have periodically made equity investments in our collaborators. As of December 31, 2018, we held strategic equity investments in CRISPR, a public company, and Moderna, which became a publicly traded company in December 2018, and certain private companies, and we may make additional strategic equity investments in the future. While we invest the majority of our cash, cash equivalents and marketable securities in instruments with low risk 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.

Until December 31, 2017, changes in the fair value of these strategic investments were reflected on our consolidated balance sheet, but did not affect our net income until the related gains or losses were realized. As a result of new accounting guidance, effective January 1, 2018, any changes in the fair value of equity investments with readily

determinable fair values (including publicly traded securities such as CRISPR and Moderna) are recorded to other income (expense), net in our consolidated statement of operations. For equity investments without readily determinable fair values (including private equity investments), each reporting period we are required to re-evaluate the carrying value of the investment, which may result in other income (expense).

In 2018, we recorded within other income (expense), net an unrealized gain of $2.6 million related to changes in the fair value of our investments in CRISPR and Moderna, which are included in our net income. In 2018, income and expenses related to these investments did not have a material effect on our annual other income (expense), but had material effects on our quarterly other income (expense). To the extent that we continue to hold strategic investments and in particular strategic investments in publicly traded companies, we will record on a quarterly basis other income (expense) related to these strategic investments. Due to the high volatility of stocks in the biotechnology industry, we expect the value of these strategic investments to fluctuate and that the increases or decreases in the fair value of these strategic investments will continue to have material impacts on our net income (expense) and our profitability under GAAP on a quarterly and/or annual basis.

RESULTS OF OPERATIONS

				2018/2017 Comparison Increase/(Decrease)		2017/2016 Comparison Increase/(Decrease)	
	2018	2017	2016	$	%	$	%
	(in thousands)			(in thousands, except percentages)			
Revenues	$3,047,597	$2,488,652	$1,702,177	$558,945	22%	$ 786,475	46 %
Operating costs and expenses	2,412,447	2,365,409	1,692,241	47,038	2 %	673,168	40 %
Other items, net	1,461,746	140,241	(121,988)	1,321,505	**	262,229	**
Net income (loss) attributable to Vertex	$2,096,896	$263,484	$(112,052)	$1,833,412	**	$ 375,536	**
Net income (loss) per diluted share attributable to Vertex common shareholders	$8.09	$1.04	$(0.46)	** Not meaningful			
Diluted shares used in per share calculations	259,185	253,225	244,685				

Net Income (Loss) Attributable to Vertex

Comparison of Net Income Attributable to Vertex 2018 vs. 2017

Net income attributable to Vertex was $2.10 billion in 2018 as compared to $263.5 million in 2017. In the fourth quarter of 2018, we recorded a one-time non-cash benefit from income taxes of $1.56 billion when we released the valuation allowance on the majority of our net operating losses and other deferred tax assets. This one-time benefit is included in other items, net in the preceding table and substantially increased the net income attributable to Vertex in 2018.

Our total revenues increased in 2018 as compared to 2017 primarily due to an $872.8 million increase in CF net product revenues, partially offset by $230.0 million in one-time collaborative revenues recorded in 2017 related to an upfront payment from Merck KGaA, Darmstadt, Germany.

Our operating costs and expenses increased in 2018 as compared to 2017 due to increased costs of sales related to our increased product revenues and increased expenses related to our ongoing research and development efforts. Our operating expenses in each of 2018 and 2017 were affected by expenses related to business development activities. In 2018, we incurred $111.6 million in research expenses primarily related to upfront payments for collaborations and license agreements that we entered into during 2018. In 2017, we incurred a $255.3 million impairment charge related to Parion’s pulmonary ENaC platform and $160.0 million in development expenses incurred in connection with our acquisition of VX-561 from Concert Pharmaceuticals, Inc., or Concert, each of which is included in operating costs and expenses in the preceding table.

Comparison of Net Income (Loss) Attributable to Vertex 2017 vs. 2016

Net income attributable to Vertex was $263.5 million in 2017 as compared to a net loss attributable to Vertex of $(112.1) million in 2016. Our revenues increased in 2017 as compared to 2016 primarily due to increased ORKAMBI and KALYDECO net product revenues and $230.0 million in one-time collaborative revenues related to the strategic collaboration and license agreement we established with Merck KGaA, Darmstadt, Germany, in 2017. Our operating costs and expenses increased in 2017 as compared to 2016 primarily due to increases in our cost of sales related to our increased net product revenues, increases in our research and development expenses, which included $160.0 million in development expenses incurred in connection with the acquisition of VX-561 from Concert, increases in our sales and administrative expenses and a $255.3 million intangible asset impairment charge related to Parion’s pulmonary ENaC platform. Other items, net in 2017 primarily reflect a benefit from income taxes and certain other benefits associated with the impairment of Parion’s pulmonary ENaC platform, for which there were no comparable benefits in 2016, and a decrease in interest expense, net to $57.6 million. Other items, net in 2016 primary reflects interest expense, net of $81.4 million, a provision for income taxes of $16.7 million and net income attributable to noncontrolling interest of $28.0 million.

Earnings Per Share

In 2018, 2017 and 2016, net income (loss) attributable to Vertex was $8.09, $1.04, $(0.46), respectively, per diluted share. The increase in our diluted earnings per share in 2018 compared to 2017 was due to, among other things, the increased net product revenues and the benefit from income taxes as a result of the release of our valuation allowance on the majority

of our net operating losses and other deferred tax assets. The release of the valuation allowance increased net income attributable to Vertex by $6.03 per diluted share.

In 2018, 2017 and 2016, the number of diluted shares used to calculate net income (loss) per common share was 259.2 million, 253.2 million and 244.7 million, respectively. The increase in diluted shares in each year was primarily due to our issuance of shares of common stock pursuant to our employee equity programs.

Revenues

				2018/2017 Comparison Increase/(Decrease)		2017/2016 Comparison Increase/(Decrease)	
	2018	2017	2016	$	%	$	%
	(in thousands)			(in thousands, except percentages)			
Product revenues, net	$3,038,325	$2,165,480	$1,683,632	$872,845	40%	$ 481,848	29 %
Collaborative and royalty revenues	9,272	323,172	18,545	(313,900)	**	304,627	**
Total revenues	$3,047,597	$2,488,652	$1,702,177	$558,945	22%	$ 786,475	46 %

** Not meaningful

Product Revenues, Net

	2018	2017	2016
	(in thousands)		
SYMDEKO/SYMKEVI	$768,657	$—	$—
ORKAMBI	1,262,166	1,320,850	979,590
KALYDECO	1,007,502	844,630	703,432
Total CF product revenues, net	$3,038,325	$2,165,480	$1,683,022

In 2018, our total CF net product revenues increased by $872.8 million as compared to 2017. The increase in total CF net product revenues was due to the increasing number of patients being treated as a result of the approval of SYMDEKO in the U.S., label expansions for KALYDECO and ORKAMBI and expanded access in ex-U.S. markets. We believe that our total CF net product revenues will increase in 2019 due primarily to increases in SYMDEKO/SYMKEVI net product revenues and further CF net product revenue growth will be dependent on when, and if, we obtain approval for our triple combination regimens. Our net product revenues are also dependent on, if, and when, we obtain additional reimbursement agreements for our CF medicines in ex-U.S. markets, particularly in the United Kingdom and France.

SYMDEKO/SYMKEVI

SYMDEKO/SYMKEVI net product revenues were $768.7 million in 2018. SYMDEKO was approved by the FDA in February 2018 and SYMKEVI was approved in the European Union in November 2018. In 2018, SYMDEKO net product revenues increased each quarter as new patients initiated treatment. We did not recognize significant net product revenues from sales of SYMKEVI during 2018. We expect SYMDEKO/SYMKEVI net product revenues to continue to increase in 2019 as compared to 2018 due to the full year impact of SYMDEKO sales in the United States and as patients begin to obtain access to SYMKEVI in ex-U.S. markets.

ORKAMBI

The approval of SYMDEKO/SYMKEVI has had a negative effect on the net product revenues from ORKAMBI as a portion of the patients who were being treated with ORKAMBI switched to SYMDEKO/SYMKEVI. Due primarily to patients switching from ORKAMBI to SYMDEKO in the United States, ORKAMBI net product revenues decreased by 4.4% in 2018 as compared to 2017. In 2018, ORKAMBI net product revenues were $1.26 billion, including $310.5 million of net product revenues from ex-U.S. markets, compared to ORKAMBI net product revenues of $1.32 billion in 2017, including $167.6 million of net product revenues from ex-U.S. markets. In 2016, ORKAMBI net product revenues were $979.6 million, including $76.4 million of net product revenues from ex-U.S. markets.

Our consolidated balance sheet includes $354.4 million collected as of December 31, 2018 in France related to ORKAMBI supplied under early access programs at the invoiced price. Pursuant to the revenue recognition guidance that

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became effective under GAAP on January 1, 2018, we have recognized limited net product revenues to date on sales of ORKAMBI in France due to ongoing pricing discussions regarding the reimbursement rate for ORKAMBI. Please refer to "Critical Accounting Policies - Revenue Recognition" below for a discussion of our accounting treatment for our early access program for ORKAMBI in France.

KALYDECO

In 2018, KALYDECO net product revenues were $1.01 billion, including $363.5 million of net product revenues from ex-U.S. markets, compared to KALYDECO net product revenues of $844.6 million in 2017, including $334.2 million of net product revenues from ex-U.S. markets. In 2016, KALYDECO net product revenues were $703.4 million, including $303.9 million of net product revenues from ex-U.S. markets. The increases year-over-year were primarily due to additional patients being treated with KALYDECO as we completed reimbursement discussions in various ex-U.S. jurisdictions and as we increased the number of patients eligible to receive KALYDECO through label expansions.

Collaborative and Royalty Revenues

Our collaborative and royalty revenues were $9.3 million, $323.2 million and $18.5 million in 2018, 2017 and 2016, respectively. In 2017, our collaborative and royalty revenues primarily included (i) $230.0 million in revenues related to the one-time upfront payment earned in 2017 from Merck KGaA, Darmstadt, Germany, and (ii) a $25.0 million milestone related to our license agreement with Janssen, Inc. for the treatment of influenza. Our 2017 collaborative and royalty revenues also included $40.0 million in revenues related to upfront and milestone payments earned by Parion in 2017 pursuant to a license agreement Parion entered into with a third party. We are not a party to the Parion license agreement and have no economic interest in either the license or these milestone payments. These revenues were included in our consolidated financial statements because we were consolidating Parion as a VIE during the first three quarters of 2017. Parion was deconsolidated as a VIE as of September 30, 2017 and any future payments received by Parion pursuant to this license agreement will no longer be recognized by us as collaborative revenue. In 2016 through 2018, our collaborative and royalty revenues also include a small amount of revenues related to a cash payment we received in 2008 when we sold our rights to certain HIV royalties and reimbursements for research and development activities and milestones related to our collaborative arrangements.

Our collaborative revenues have historically fluctuated significantly from one period to another and may continue to fluctuate in the future. Our future royalty revenues will be dependent on if, and when, our collaborators, including Janssen, Inc. and Merck KGaA, Darmstadt, Germany are able to successfully develop drug candidates that we have out-licensed to them.

Operating Costs and Expenses

				2018/2017 Comparison Increase/(Decrease)		2017/2016 Comparison Increase/(Decrease)	
	2018	2017	2016	$	%	$	%
	(in thousands)			(in thousands, except percentages)			
Cost of sales	$409,539	$275,119	$210,460	$134,420	49%	$ 64,659	31 %
Research and development expenses	1,416,476	1,324,625	1,047,690	91,851	7 %	276,935	26 %
Sales, general and administrative expenses	557,616	496,079	432,829	61,537	12%	63,250	15 %
Restructuring (income) expenses	(184)	14,246	1,262	(14,430)	**	12,984	**
Intangible asset impairment charges	29,000	255,340	—	(226,340)	**	255,340	**
Total costs and expenses	$2,412,447	$2,365,409	$1,692,241	$47,038	2 %	$ 673,168	40 %

** Not meaningful

Cost of Sales

Our cost of sales primarily consists of the cost of producing inventories that corresponded to product revenues for the reporting period, plus the third-party royalties payable on our net sales of our products. Pursuant to our agreement with the CFF, our tiered third-party royalties on sales of SYMDEKO/SYMKEVI, KALYDECO and ORKAMBI, calculated as a percentage of net sales, range from the single digits to the sub-teens. As a result of the tiered royalty

rate, which resets annually, our cost of sales as a percentage of CF net product revenues are lower at the beginning of each calendar year.

Over the last several years, our cost of sales has been increasing primarily due to increased net product revenues. Our costs of sales as a percentage of CF net product revenues increased from 12.7% in 2017 to 13.5% in 2018 due to the tiered royalties that we pay to the CFF. In 2019, we expect our total cost of sales will increase due to expected increases in our CF net product revenues and that our cost of sales as a percentage of total CF net product revenues will be similar to our cost of sales as a percentage of total CF net product revenues in 2018.

Research and Development Expenses

				2018/2017 Comparison Increase/(Decrease)		2017/2016 Comparison Increase/(Decrease)	
	2018	2017	2016	$	%	$	%
	(in thousands)			(in thousands, except percentages)			
Research expenses	$438,360	$311,206	$314,602	$127,154	41 %	$(3,396)	(1)%
Development expenses	978,116	1,013,419	733,088	(35,303)	(3)%	280,331	38 %
Total research and development expenses	$1,416,476	$1,324,625	$1,047,690	$91,851	7 %	$276,935	26 %

Our research and development expenses include internal and external costs incurred for research and development of our drugs and drug candidates and expenses related to certain technology that we acquire or license through business development transactions. 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 drugs or drug candidates, because the employees within our research and development groups typically are deployed across multiple research and development programs. These internal costs are greater than our external costs, such as the costs of services provided to us by clinical research organizations and other outsourced research, which we allocate by individual program. All research and development costs for our drugs and drug candidates are expensed as incurred.

Over the past three years, we have incurred $3.8 billion in research and development expenses associated with drug discovery and development. The successful development of our drug 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 drug 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 drug candidates to market are not available.

In 2016, 2017 and 2018, costs related to our CF programs represented the largest portion of our development costs. Any estimates regarding development and regulatory timelines for our drug candidates are highly subjective and subject to change. In the fourth quarter of 2018, we obtained positive data from two Phase 3 clinical trials evaluating the triple combination of VX-659, tezacaftor and ivacaftor and we plan to submit an NDA to the FDA for a triple combination regimen with VX-659 or VX-445 no later than mid-2019. We cannot make a meaningful estimate when, if ever, our other clinical development programs will generate revenues and cash flows.

Research Expenses

				2018/2017 Comparison Increase/(Decrease)		2017/2016 Comparison Increase/(Decrease)	
	2018	2017	2016	$	%	$	%
	(in thousands)			(in thousands, except percentages)			
Research Expenses:							
Salary and benefits	$87,773	$81,229	$80,845	$6,544	8 %	$384	<1%
Stock-based compensation expense	62,925	60,122	51,034	2,803	5 %	9,088	18 %
Laboratory supplies and other direct expenses	50,578	45,822	43,151	4,756	10 %	2,671	6 %
Outsourced services	38,777	39,497	33,682	(720)	(2)%	5,815	17 %
Collaboration and asset acquisition expenses	111,600	8,425	33,000	103,175	**	(24,575)	**
Infrastructure costs	86,707	76,111	72,890	10,596	14 %	3,221	4 %
Total research expenses	$438,360	$311,206	$314,602	$127,154	41 %	$(3,396)	(1)%

** Not meaningful

We maintain a substantial investment in research activities. Our research expenses have been affected, and are expected to continue to be affected, by research expenses associated with our business development activities. In particular, in 2018 our research expenses increased primarily due to $111.6 million in research expenses associated with our business development activities, including upfront payments for certain collaboration agreements, which are reflected in collaboration and asset acquisition expenses in the table above. Collaboration and asset acquisition expenses in 2018 primarily related to agreements we entered into with Arbor Biotechnologies and Merck KGaA, Darmstadt, Germany. Collaboration and asset acquisition expenses in 2016 included expenses related to a collaboration we entered into with Moderna. We expect to continue to invest in our research programs with a focus on identifying drug candidates with the goal of creating transformative medicines for serious diseases.

Development Expenses

				2018/2017 Comparison Increase/(Decrease)		2017/2016 Comparison Increase/(Decrease)	
	2018	2017	2016	$	%	$	%
	(in thousands)			(in thousands, except percentages)			
Development Expenses:							
Salary and benefits	$220,128	$208,769	$177,399	$11,359	5 %	$31,370	18 %
Stock-based compensation expense	140,187	121,778	102,417	18,409	15 %	19,361	19 %
Laboratory supplies and other direct expenses	84,900	45,594	42,861	39,306	86 %	2,733	6 %
Outsourced services	344,339	337,901	282,137	6,438	2 %	55,764	20 %
Collaboration and asset acquisition expenses	250	160,250	—	(160,000)	**	160,250	**
Drug supply costs	42,099	13,660	12,510	28,439	208 %	1,150	9 %
Infrastructure costs	146,213	125,467	115,764	20,746	17 %	9,703	8 %
Total development expenses	$978,116	$1,013,419	$733,088	$(35,303)	(3)%	$280,331	38 %

** Not meaningful

Our development expenses decreased by $35.3 million, or 3%, in 2018 as compared to 2017 and increased by $280.3 million, or 38%, in 2017 as compared to 2016. The decrease in 2018 as compared to 2017 was primarily due to the $160.0 million payment to Concert in connection with the acquisition of VX-561 in 2017 for which there were no comparable expenses in 2018, partially offset by increased costs associated with ongoing clinical trials, including Phase 3 clinical trials evaluating our next-generation CFTR corrector compounds as part of triple combination treatment regimens.

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The increase in 2017 as compared to 2016 was primary due to the $160.0 million payment in 2017 to Concert and to increased outsourced services related to clinical trials.

Sales, General and Administrative Expenses

				2018/2017 Comparison Increase/(Decrease)		2017/2016 Comparison Increase/(Decrease)	
	2018	2017	2016	$	%	$	%
	(in thousands)			(in thousands, except percentages)			
Sales, general and administrative expenses	$557,616	$496,079	$432,829	$61,537	12%	$ 63,250	15 %

Sales, general and administrative expenses increased by 12% in 2018 as compared to 2017, and by 15% in 2017 as compared to 2016. These increases were primarily due to increased global support for our products. We expect our sales, general and administrative expenses to continue to increase in 2019.

Restructuring Expenses

In 2018, 2017 and 2016, we recorded restructuring (income) expenses of $(0.2) million, $14.2 million and $1.3 million, respectively. Our restructuring expenses in 2017 were primarily related to our decision to consolidate our research activities into our Boston, Milton Park and San Diego locations and to close our research site in Canada.

Intangible Asset Impairment Charge

In 2018, we recorded a $29.0 million impairment charge attributable to non-controlling interest related to VX-210 that was licensed from BioAxone in 2014. In 2017, we recorded a $255.3 million impairment charge related to Parion's pulmonary ENaC platform that we licensed from Parion in 2015 and a benefit from income taxes of $97.7 million related to this impairment charge attributable to non-controlling interest. There were no corresponding intangible asset impairment charges in 2016.

Other Items, Net

Interest Expense, Net

Our interest expense, net relates primarily to interest expenses associated with certain of our real estate leases and outstanding debt, if any, partially offset by interest income from the investment of our cash equivalents and marketable securities. In 2018, 2017 and 2016, interest expense, net was $34.1 million, $57.6 million and $81.4 million, respectively. The decrease in interest expense, net in 2018 as compared to 2017 was primarily due to an increase in our interest income resulting from an increase in our cash equivalents and marketable securities. The decrease in interest expense, net in 2017 as compared to 2016 was primarily due to the repayment of the $300.0 million outstanding under our revolving credit facility in February 2017. In 2019, we expect that we will incur approximately $52 million in interest expenses related to our real estate leases, including a decrease in 2019 as compared to 2018 of approximately $13 million based on updated accounting guidance related to aspects of lease accounting that became effective January 1, 2019. In addition to the updated accounting guidance, our future net interest expense will also be dependent on whether, and to what extent, we reborrow amounts under our credit facility and the amount of and prevailing market interest rates on our outstanding cash equivalents and marketable securities.

Other Income (Expense), Net

In 2018, we recorded net other expense of $0.8 million. In 2017, we recorded net other expense of $81.4 million primarily related to the deconsolidation of Parion. In 2016, we recorded net other income of $4.1 million primarily related to foreign exchange gains.

In 2018, our other income (expense), net fluctuated significantly on a quarterly basis based on the fair value of our strategic investments. While the annual effect on our other income (expense), net from our investments in CRISPR and Moderna was a gain of $2.6 million, the value of these investments increased by $149.4 million in the first half of 2018 and decreased by $146.8 million in the second half of 2018. We expect that due to the volatility of the stock price of

biotechnology companies our other income (expense), net will fluctuate based on increases or decreases in the fair value of our strategic investments including CRISPR and Moderna.

Income Taxes

In 2018, we recorded a benefit from income taxes of $1.49 billion. In 2017 and 2018, we were profitable from a U.S. federal income tax perspective and have used a portion of our net operating losses to offset this income since becoming profitable. Until the fourth quarter of 2018, we maintained a valuation allowance on the majority of our net operating losses and other deferred tax assets. Due to this valuation allowance, we did not record a significant provision for income taxes in 2016, 2017 and the nine months ended September 30, 2018. In the fourth quarter of 2018, we released the valuation allowance resulting in a non-cash credit to net income of $1.56 billion. Further information on the release of the valuation allowance and significant judgments related to its release can be found below in “Critical Accounting Policies - Income Taxes.”

In 2019, we expect to continue to utilize our net operating losses to offset income, but would begin recording a significant provision for income taxes reflecting the utilization of the deferred tax assets. The majority of this provision for income taxes will be a non-cash expense until our net operating losses are fully utilized.

In 2017, we recorded a benefit from income taxes of $107.3 million, primarily due to a total benefit from income taxes of $114.1 million attributable to noncontrolling interest related to the impairment of Parion’s pulmonary ENaC platform and decrease in the fair value of the contingent payments payable by us to Parion. In 2016, we recorded a provision for income taxes of $16.7 million, principally due to income taxes payable by our VIEs.

Noncontrolling Interest (VIEs)

The net loss (income) attributable to noncontrolling interest (VIEs) recorded on our consolidated statements of operations reflects Parion (through September 30, 2017) and BioAxone’s net (income) loss for the reporting period, adjusted for any changes in the noncontrolling interest holders’ claim to net assets, including contingent milestone, royalty and option payments. A summary of net (income) loss attributable to noncontrolling interest related to our VIEs for the three years ended December 31, 2018 is as follows:

	2018	2017	2016
	(in thousands)		
Loss attributable to noncontrolling interest before (benefit from) provision for income taxes and changes in fair value of contingent payments	$31,191	$223,379	$10,086
(Benefit from) provision for income taxes	(3,668)	(114,090)	16,743
(Increase) decrease in fair value of contingent payments	(17,730)	62,560	(54,850)
Net loss (income) attributable to noncontrolling interest	$9,793	$171,849	$(28,021)

In 2018, the net loss attributable to noncontrolling interest was primarily related to the $29.0 million impairment charge related to VX-210 offset by an increase in the fair value of the contingent payments payable by us to BioAxone of $17.7 million primarily due to the expiration of our option to purchase BioAxone in 2018. In 2017, the net loss attributable to noncontrolling interest was primarily related to the $255.3 million impairment charge related to Parion’s pulmonary ENaC platform, a decrease in fair value of the contingent payments payable by us to Parion of $69.6 million upon deconsolidation and benefit from income taxes of $126.2 million related to these charges. In 2016, the net income attributable to noncontrolling interest was primarily related to an increase in the fair value of contingent payments based on a Phase 2 clinical trial of VX-371 achieving its primary safety endpoint.

LIQUIDITY AND CAPITAL RESOURCES

The following table summarizes the components of our financial condition as of December 31, 2018 and 2017:

			Increase/(Decrease)	
	2018	2017	$	%
	(in thousands, except percentages)			
Cash, cash equivalents and marketable securities	$3,168,242	$2,088,666	$1,079,576	52 %
Working Capital				
Total current assets	$3,843,109	$2,648,963	$1,194,146	45 %
Total current liabilities	(1,120,292)	(807,260)	(313,032)	39 %
Total working capital	$2,722,817	$1,841,703	$881,114	48 %

As of December 31, 2018, we had cash, cash equivalents and marketable securities of $3.2 billion, which represented an increase of $1.1 billion from $2.1 billion as of December 31, 2017. In 2018, our cash, cash equivalents and marketable securities balance increased primarily due to cash receipts from product sales and $289.3 million of cash received from issuances of common stock under our employee benefit plans partially offset by cash expenditures to fund our operations and $350.0 million of cash used to repurchase shares of our common stock. We expect that our future cash flows will be substantially dependent on our CF product sales.

As of December 31, 2018, total working capital was $2.7 billion, which represented an increase of $881.1 million from $1.8 billion as of December 31, 2017. The most significant items that increased total working capital in 2018 were $1.3 billion of cash provided by operations and $289.3 million of cash received from issuances of common stock under our employee benefit plans partially offset by $350.0 million of cash used to repurchase shares of our common stock and expenditures for property and equipment of $95.5 million as well as other expenditures.

Sources of Liquidity

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 are receiving cash flows from sales of KALYDECO and ORKAMBI in the United States and ex-U.S. markets and from SYMDEKO in the United States. We will begin receiving cash flows from sales of SYMKEVI in the European Union in 2019. Future net product revenues from ex-U.S. markets will be dependent on, among other things, the timing of and our ability to complete reimbursement discussions in European countries.

We may borrow up to $500.0 million pursuant to a revolving credit facility that we entered into in 2016. We may repay and reborrow amounts under the revolving credit agreement without penalty. Subject to certain conditions, we may request that the borrowing capacity under this credit agreement be increased by an additional $300.0 million.

In 2018 and 2017, we received significant proceeds from the issuance of common stock under our employee benefit plans and more limited proceeds from employee benefit plans in 2016. The amount and timing of future proceeds from employee benefits plans is uncertain. In 2018, the value of our strategic investment in CRISPR fluctuated on a quarterly basis. The future value of our strategic investments, including our investments in CRISPR and Moderna, is uncertain. Other possible sources of future liquidity include strategic collaborative agreements that include research and/or development funding, commercial debt, public and private offerings of our equity and debt securities, development milestones and royalties on sales of products, software and equipment leases, strategic sales of assets or businesses and financial transactions. Negative covenants in our credit agreement may prohibit or limit our ability to access these sources of liquidity.

Future Capital Requirements

We have significant future capital requirements including:

- incurring substantial operating expenses to conduct research and development activities and to operate our organization; and
- having substantial facility and capital lease obligations, including leases for two buildings in Boston, Massachusetts that continue through 2028 and a lease in San Diego, California that continues through 2034.

In addition,

- As of December 31, 2018, we have accrued approximately $354.4 million from ORKAMBI early access programs in France. We expect we will be required to repay a portion of the collected amounts to the French government

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based on the difference between the invoiced price of ORKAMBI and the final price for ORKAMBI in France once we conclude our ongoing pricing discussions with the French government.

- We have entered into certain collaboration agreements with third parties that include the funding of certain research, development and commercialization efforts with the potential for future milestone and royalty payments by us upon the achievement of pre-established developmental and regulatory targets and/or commercial targets, and we may enter into additional business development transactions, including acquisitions, collaborations and equity investments, that require additional capital. For example, in 2018 and 2017, we made $100.4 million and $168.7 million of upfront and milestone payments related to collaborations and asset acquisitions.
- To the extent we borrow amounts under the credit agreement we entered into in October 2016, we would be required to repay any outstanding principal amounts in 2021.

In January 2018, we announced a share repurchase program to repurchase up to $500.0 million of shares of our common stock through December 31, 2019. As of December 31, 2018, $150.0 million remained available to fund repurchases under the share repurchase program.

We expect that cash flows from our CF 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 CF products, and the potential introduction of one or more of our other drug candidates to the market, including a triple combination regimen for patients with CF, the level of our business development activities and the number, breadth, cost and prospects of our research and development programs.

Financing Strategy

We may 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.

CONTRACTUAL COMMITMENTS AND OBLIGATIONS

The following table sets forth our commitments and obligations as of December 31, 2018:

	Payments Due by Period				
	2019	2020-2021	2022-2023	2024 and later	Total
	(in thousands)				
Fan Pier Leases	$66,540	$145,178	$145,178	$389,855	$746,751
Facility leases, excluding Fan Pier Leases	18,531	45,053	42,654	185,336	291,574
Capital lease obligations	10,770	12,931	5,274	3,085	32,060
Research, development and drug supply costs	20,579	3,316	314	—	24,209
Other	5,563	2,995	106	5,619	14,283
Total contractual commitments and obligations	$121,983	$209,473	$193,526	$583,895	$1,108,877

Leases

We lease two buildings that are located at Fan Pier in Boston, Massachusetts. We commenced lease payments on these two buildings in December 2013 and the initial lease periods end in December 2028. We also lease office and laboratory space in San Diego, California and will commence base rent payments for this building in the second quarter of 2019 pursuant to a 16 year lease. The future minimum rental payments that we are obligated to pay related to the San Diego building are included in “Facility leases, excluding Fan Pier Leases.” The table also reflects leases of equipment that are accounted for as capital leases.

Research, Development and Drug Supply Costs

The amounts reflected in “Research, development and drug supply costs,” do not include certain payments we anticipate making to clinical research organizations, or CROs, because these contracts are cancelable, at our option, with notice. However, we historically have not cancelled such contracts. As of December 31, 2018, we had accrued $53.1 million

related
to these contracts for costs incurred for services provided through December 31, 2018, and we have approximately $177.0 million in cancelable future commitments based on existing contracts as of December 31, 2018. These amounts reflect planned expenditures based on existing contracts and do not reflect any future modifications to, or terminations of, existing contracts or anticipated or potential new contracts.

Collaborative Arrangements and Asset Acquisitions

We have entered into certain research and development collaboration agreements with third parties and acquired certain assets that include the funding of certain development, manufacturing and commercialization efforts with the potential for future milestone and royalty payments by us upon the achievement of pre-established developmental, regulatory and/or commercial targets. Our obligation to fund these efforts is contingent upon continued involvement in the programs and/or the lack of any adverse events that could cause the discontinuance of the programs. These payments include:

- CFF: CFF has the right to tiered royalties ranging from single digits to sub-teens on any approved drugs first synthesized and/or tested during a research term on or before February 28, 2014, including KALYDECO, ORKAMBI, SYMDEKO/SYMKEVI, lumacaftor, ivacaftor and tezacaftor and royalties ranging from low single digits to mid-single digits on potential sales of certain compounds first synthesized and/or tested between March 1, 2014 and August 31, 2016, including VX-659 and VX-445. For combination products, such as ORKAMBI and SYMDEKO/SYMKEVI, sales are allocated equally to each of the active pharmaceutical ingredients in the combination product.
- Research and Development Milestones: Our collaborations and certain other business development arrangements, including our asset acquisition from Concert, have milestone and royalty payments payable by us upon the successful achievement of pre-established developmental, regulatory and/or commercial targets or net sales.

Contingent payments under these agreements become due and payable only upon achievement of certain milestones and are not included in the contractual obligations table above.

Tax-related Obligations

We exclude liabilities pertaining to uncertain tax positions from our summary of contractual obligations as we cannot make a reliable estimate of the period of cash settlement with the respective taxing authorities. As of December 31, 2018, our liabilities associated with uncertain tax positions were $19.5 million.

Other Funding Commitments

Our table detailing contractual commitments and obligations does not include severance payment obligations to certain of our executive officers in the event of a not-for-cause employment termination under existing employment contracts. We will provide information regarding these obligations annually in our proxy statement for our annual meeting of shareholders.

In addition, as discussed below, we began distributing ORKAMBI through early access programs in France in 2015 at the invoiced price and are engaged in ongoing pricing discussions regarding the final price for ORKAMBI in France. We expect the difference between the amounts collected at the invoiced price and the final price for ORKAMBI in France will be returned to the French government and that this amount could be material.

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 United States. 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;
- income taxes;
- research and development accruals;
- leases; and
- collaborations; intangible assets and variable interest entities.

Our accounting policies, including the ones discussed below, are more fully described in the Notes to our consolidated financial statements, including Note A, “Nature of Business and Accounting Policies,” included in this Annual Report on Form 10-K.

Revenue Recognition

Product Revenues, Net

We generate product revenues from sales in the United States and in international markets. We sell our products principally to a limited number of specialty pharmacy and specialty distributors in the United States, which account for the largest portion of our total revenues, and make international sales primarily to specialty distributors and retail chains, as well as hospitals and clinics, many of which are government-owned or supported customers, collectively, our customers. Our customers in the United States 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 value 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. In order 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 on new information, including information regarding actual rebates for our products, as it becomes available. 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 the three years ended December 31, 2018:

	(in thousands)
Balance as of December 31, 2015	$ 44,669
Provision related to current period sales	134,198
Adjustments related to prior period sales	154
Credits/payments made	(97,094)
Balance as of December 31, 2016	$ 81,927
Provision related to current period sales	176,996
Adjustments related to prior period sales	(8,943)
Credits/payments made	(137,765)
Balance as of December 31, 2017	$ 112,215
Provision related to current period sales	330,883
Adjustments related to prior period sales	(22,099)
Credits/payments made	(229,361)
Balance as of December 31, 2018	$ 191,638

We have also entered into 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. We defer a portion of the consideration received, which include upfront payment and fees, for shipments made up to the annual reimbursement limit and the deferred amount is recognized as revenue when the free products are shipped. In order to estimate the portion of the consideration received to recognize as revenue and the portion of the amount to defer, 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 affect on net product revenues recorded in the period in which we determine that change occurs.

French Early Access Programs

We began distributing ORKAMBI through early access programs in France in 2015 and are engaged in ongoing pricing discussions regarding the final price for ORKAMBI in France. Our consolidated balance sheets included $354.4 million and $232.4 million collected as of December 31, 2018 and 2017, respectively, in France related to ORKAMBI that are classified as “Early access sales accrual” related to amounts collected in France as payment for shipments of ORKAMBI under the early access programs at the invoiced price. We expect the difference between the amounts collected at the invoiced price and the final price for ORKAMBI in France will be returned to the French government.

We did not recognize ORKAMBI net product revenues from sales in France under the accounting guidance that was applicable until December 31, 2017. Pursuant to ASC 606, which we adopted on January 1, 2018, we recorded an $8.3 million cumulative effect adjustment to “Accumulated deficit” primarily related to ORKAMBI net product revenues from sales in France and we began recognizing ORKAMBI net product revenues based on our estimate of consideration we expect to retain that will not be subject to a significant reversal, which results in recognized revenue that represents a small percentage of the invoiced price. If our estimates regarding the amounts we will receive pursuant to these programs change, we will reflect the effect of the change in estimate in net product revenues in the period in which the change in estimate occurs and will include adjustments to all prior sales of ORKAMBI under the early access programs. Depending on the final price of ORKAMBI and because the current estimate is based on the amount that will not be subject to a significant reversal in amounts recognized, this adjustment could be material.

Collaborative and Royalty Revenues

We recognize collaborative and royalty revenues generated through collaborative research, development and/or commercialization agreements. The terms of these agreements typically include payment to us of one or more of the following: nonrefundable, upfront license fees; development and commercial milestone payments; funding of research and/or development activities; and royalties on net sales of licensed products.

In connection, with upfront license fees and milestone payments we receive from these agreements we are required to determine the amount and timing of revenue recognition. These payments can either be recognized immediately or as we complete the performance obligations that we identify as required by the applicable accounting standard. In order to make this determination, we identify all material performance obligations, which may include a license to intellectual property and know-how, research and development activities and/or transition activities. In order to determine the transaction price, in addition to any upfront payment, we estimate the amount of variable consideration at the outset of the contract utilizing either the expected value method or most likely amount method, depending on the facts and circumstances relative to the contract. We constrain (reduce) the estimate of variable consideration such that it is probable that a significant reversal of previously recognized revenue will not occur throughout the life of the contract. When determining if variable consideration should be constrained, we consider whether there are factors outside our control that could result in a significant reversal of revenue. In making these assessments, we consider the likelihood and magnitude of a potential reversal of revenue.

Once the estimated transaction price is established, amounts are allocated to the performance obligations that have been identified. The transaction price is generally allocated to each separate performance obligation on a relative standalone selling price basis. In order to account for these agreements, we must develop assumptions that require judgment to determine the standalone selling price, which may include (i) the probability of obtaining marketing approval for the drug candidate, (ii) estimates regarding the timing of and the expected costs to develop and commercialize the drug candidate, (iii) estimates of future cash flows from potential product sales with respect to the drug candidate and (iv) appropriate discount and tax rates.

Income Taxes

We were engaged in research and development activities and incurred significant net operating losses for a number of years before recently becoming profitable. Since we started generating profits, we have used a portion of our net operating losses and maintained a valuation allowance on the majority of our net operating losses and other deferred tax assets until December 31, 2018. Accordingly, we have not reported any tax benefits relating to our net operating loss carryforwards and income tax credit carryforwards that are available for utilization in future periods. As of December 31, 2018, we released the valuation allowance on the majority of our net operating losses and other deferred tax assets resulting in a non-cash benefit from income taxes of $1.56 billion in the fourth quarter of 2018.

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. In the fourth quarter of 2018, we reassessed our valuation allowances and considered positive evidence including significant cumulative consolidated and U.S. income over the three years ended December 31, 2018, revenue growth, clinical program progression, including the advancement and clinical trial data from our triple combination regimens, and expectations regarding future profitability, and negative evidence, including potential impact of competition on our projections and cumulative losses in on the jurisdictions. After assessing both the positive evidence and the negative evidence, we released the valuation allowance on the majority of our net operating losses and other deferred tax assets as of December 31, 2018. 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. The determination to release the majority of our valuation allowances increased our net income by $1.56 billion, or $6.03 per share in 2018. In 2019, due to our release of the majority of our valuation allowance in 2018, we expect to continue to utilize our net operating losses to offset income, but expect to begin recording a significant provision for income taxes reflecting the utilization of our deferred tax assets.

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.

Research and Development Accruals

Research and development expenses, including amounts funded through research and development collaborations, are expensed as incurred. When third-party service providers' billing terms do not coincide with our period-end, we are required to make estimates of our obligations to those third parties, including clinical trial and pharmaceutical development costs, contractual services costs, costs for drug supply, marketing expenses and infrastructure expenses incurred in a given

accounting period and record accruals at the end of the period. We base our estimates on our knowledge of the research and development programs, services performed for the period, experience with related activities and the expected duration of the third-party service contract, where applicable. Due to the scope of the research and development activities being conducted and the complexity of our clinical expense models, the estimates and judgments that we make affect the timing of our research and development expense for a reporting period and the related accruals on our consolidated balance sheet. These estimates are not likely to significantly affect the total expense we record over the course of a clinical trial or other research and development activity.

Leases

Our leases, and in particular the leases for our primary facilities, require significant judgment in order to determine the levels of operating expenses and interest expenses we record to our consolidated statement of operations and the amounts recorded on our consolidated balance sheet associated with the leases:

- Until December 31, 2018, we were required to determine whether we would be deemed for accounting purposes to be the owner of these buildings as they were constructed. Upon completion of these buildings, we were required to determine whether or not the underlying leases met the criteria for "sale-leaseback" treatment.
- Beginning on January 1, 2019, in accordance with ASC 842, Leases ("ASC 842"), we will be required to determine whether the leases associated with these buildings will be reflected as financing leases or operating leases.

As of December 31, 2018, because our corporate headquarters and San Diego building did not qualify for sale-leaseback treatment when construction was completed, we recorded the cost of construction of these buildings as "Property and equipment, net" and the related lease obligations as "Construction financing lease obligation," on our consolidated balance sheets. Accordingly, we depreciated the assets and incurred interest expense associated with the financing obligation for these buildings. We bifurcated our lease payments pursuant to the leases into (i) a portion that is allocated to the buildings and (ii) a portion that is allocated to the land on which the buildings were constructed. In 2018, we incurred approximately (1) $15 million in depreciation expense and $7 million in rent expense, each of which is included in our operating expenses and (2) $65 million in interest expenses, related to these leases. The amounts reflected on our consolidated balance sheet and expenses incurred on our consolidated statement of operations required estimates regarding the useful life of the building and appropriate discount rates.

Beginning on January 1, 2019, we are accounting for our primary facilities under ASC 842. ASC 842 continues to require us to use significant judgment to determine whether these buildings should be accounted for as financing or operating leases including the fair value of the buildings at the inception of the lease and appropriate discount rates. Whether the buildings are recorded as financing or operating leases will result in significant shifts in the classification of expenses between operating expenses and interest expense on our consolidated statement of operations. This determination will also impact the amount and classification of assets and liabilities on our consolidated balance sheet. Under ASC 842, we will account for our corporate headquarters and San Diego buildings as financing leases requiring us to account for these buildings over their respective lease terms, which are significantly shorter than these buildings' useful lives. Under previous guidance, we utilized an estimated useful life of 40 years for these buildings consistent with a useful life an owner would apply to its buildings. As a result, we depreciated the buildings over 40 years, which also impacted the amount of interest expense that we recorded on an annual basis. As a result, in 2019, we expect we will record the following related to our corporate headquarters and San Diego leases: (i) operating expenses of approximately $48 million (an increase of approximately $26 million compared to 2018) and (ii) interest expense of approximately $52 million (a decrease of approximately $13 million compared to 2018).

Collaborations; Intangible Assets and Variable Interest Entities

Our collaborations require us to apply accounting policies that involve significant judgments and that have a material effect on our consolidated financial statements. For example, in 2017, we deconsolidated Parion, a VIE that we had consolidated since 2015, and recorded an intangible asset impairment charge of $255.3 million related to Parion's pulmonary ENaC platform.

We review each collaboration agreement pursuant to which we license assets owned by a collaborator in order to determine whether we have a variable interest via the license agreement with the collaborator and if the variable interest is a variable interest in the collaborator as a whole. In connection with this assessment, we consider and make judgments regarding the following, among other factors: (1) whether the collaborator is a business; (2) the purpose

and design of the collaborator; (3) the value of the licensed asset(s) as compared to the value of the collaborator as a whole; and (4) which party has the power to direct the activities that most significantly affect the collaborator's economic performance.

We evaluate on a quarterly basis if we continue to have a variable interest in each VIE and are the primary beneficiary of the VIE, and if we later determine that we no longer have a variable interest or are no longer the primary beneficiary, we deconsolidate the applicable VIE. This evaluation involves an assessment of the activities being conducted pursuant to our collaboration agreement with the collaborator, the collaborator's financial statements, discussions with the collaborator's management regarding its other activities, including any new collaborations, financing activities, clinical data and the collaborator's other programs.

We believe that the following effects of the consolidation and deconsolidation of VIEs on our consolidated financial statements are the most significant:

- In periods in which we consolidate a VIE, we record net income (loss) attributable to our VIEs' noncontrolling interest. This net income (loss) reflects our VIEs' net income (loss) for the period as adjusted for gains and losses in the fair value of the contingent payments, which consist of milestone, royalty and option payments, payable by us to our VIEs. The changes in the fair value of contingent payments decrease or increase our net loss attributable to Vertex on a dollar-for-dollar basis.
- We recorded $255.3 million and $29.0 million, respectively, of intangible assets on our consolidated balance sheet based on our estimate of the fair value of Parion's and BioAxone's indefinite-lived in-process research and development assets as of the applicable transaction date. We maintain these assets on our consolidated balance sheet until either the research and development project underlying it is completed or the asset becomes impaired. 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. We assess the fair value of these assets using a variety of methods, including present-value models that are based on multiple probability-weighted scenarios involving the development and potential commercialization of the underlying drug candidates. In 2017 and 2018, we recorded full impairment changes for the indefinite-lived in-process research and development assets that were related to our collaborations with Parion and BioAxone, respectively. As a result, we did not have any indefinite-lived intangible assets recorded on our consolidated balance sheet as of December 31, 2018.
- In order to account for the fair value of the intangible assets and contingent payments related to collaborations with our VIEs, we use present-value models based on assumptions regarding the probability of achieving the relevant milestones, estimates regarding the timing of achieving the milestones, estimates of future product sales and the appropriate discount rates. Significant judgment is used in determining the appropriateness of these assumptions during each reporting period. Changes in these assumptions could have a material effect on the fair value of the contingent payments and affect the analysis of whether or not an intangible asset is impaired.
- The revenues, research and development expenses and sales, general and administrative expenses of our VIEs that are unrelated to the programs that we in-license from our VIEs and that are consolidated into our financial statements are set forth in the table below and represent approximately 2% or less of our revenues, research and development expenses and sales, general and administrative expenses in each period:

	2018	2017	2016
	(in thousands)		
Revenues	$1,840	$43,376	$944
Research and development expenses	(2,114)	(7,729)	(6,762)
Sales, general and administrative expenses	(2,029)	(3,826)	(4,160)
Other items, net	(28,888)	(255,200)	(108)
Loss attributable to noncontrolling interest before (benefit from) provision for income taxes and changes in fair value of contingent payments	$(31,191)	$(223,379)	$(10,086)

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 2018.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

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 until it is required to fund operations, including our research and development

activities. None of these market risk-sensitive instruments are held for trading purposes. We do not have derivative financial instruments in our investment portfolio.

Interest Rate Risk

We invest our cash in a variety of financial instruments, principally 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. All of our interest-bearing securities are subject to interest rate risk and could decline 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. Due to the conservative nature of these instruments, we do not believe that we have a material exposure to interest rate risk. If interest rates were to increase or decrease by 1%, the fair value of our investment portfolio would increase or decrease by an immaterial amount.

In 2016, we entered into a credit agreement. Loans under the credit agreement bear interest, at our option, at either a base rate or a Eurodollar rate, in each case plus an applicable margin. The applicable margin on base rate loans ranges from 0.75% to 1.50% and the applicable margin on Eurodollar loans ranges from 1.75% to 2.50%, in each case, based on our consolidated leverage ratio (as defined in the credit agreement). We do not believe that changes in interest rates related to the credit agreement would have a material effect on our financial statements. As of December 31, 2018, we had no principal or interest outstanding. A portion of our “Interest expense, net” in 2019 will be dependent on whether, and to what extent, we reborrow amounts under the existing facility.

Foreign Exchange Market Risk

As a result of our foreign operations, we face exposure to movements in foreign currency exchange rates, primarily the Euro and British Pound against the U.S. Dollar. The current exposures arise primarily from cash, accounts receivable, intercompany receivables and payables, payables and accruals and inventories. Both positive and negative effects to our net revenues from international product sales from movements in exchange rates are partially mitigated by the natural, opposite effect that exchange rates have on our international operating costs and expenses.

We have a foreign currency management program with the objective of reducing the effect of exchange rate fluctuations on our operating results and forecasted revenues and expenses denominated in foreign currencies. We currently have cash flow hedges for the Euro, British Pound, Canadian Dollar 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, 2018, we held foreign exchange forward contracts that were designated as cash flow hedges with notional amounts totaling $505.2 million and had a net fair value of $20.1 million recorded 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. Assuming that the December 31, 2018 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, 2018 would change by approximately $50.5 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 (loss)” on our consolidated balance sheet 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.

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

The information required by this Item 8 is contained on pages F-1 through F-53 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. The Company's chief executive officer and chief financial officer, after evaluating the effectiveness of the Company's 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, the Company's disclosure controls and procedures were effective. In designing and evaluating the disclosure controls and procedures, the Company's 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 the Company's management necessarily was required to apply its judgment in evaluating the cost-benefit relationship of possible controls and procedures.

(2) Management's Annual Report on Internal Control Over Financial Reporting. The management of the Company 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, the Company's principal executive and principal financial officers and effected by the Company's 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. The Company's internal control over financial reporting includes those policies and procedures that:

- pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the Company;
- 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
- 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.

The Company's management assessed the effectiveness of the Company's internal control over financial reporting as of December 31, 2018. In making this assessment, it used the criteria set forth in the Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework)(COSO). Based on its assessment, the Company's management has concluded that, as of December 31, 2018, the Company's internal control over financial reporting is effective based on those criteria.

The Company's independent registered public accounting firm, Ernst & Young LLP, issued an attestation report on the Company's internal control over financial reporting. See Section 4 below.

(3) Changes in Internal Controls. During the quarter ended December 31, 2018, there were no changes in the Company's internal control over financial reporting that materially affected, or are reasonably likely to materially affect, the Company's 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, 2018, 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, 2018, 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 consolidated balance sheets of Vertex Pharmaceuticals Incorporated as of December 31, 2018 and 2017, the related consolidated statements of operations, comprehensive income (loss), shareholders' equity and noncontrolling interest, and cash flows for each of the three years in the period ended December 31, 2018, and the related notes and our report dated February 13, 2019 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 Annual Report on Internal Control Over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission of 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 13, 2019

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ITEM 9B. OTHER INFORMATION
Not applicable.

PART III

Portions of our definitive Proxy Statement for the 2019 Annual Meeting of Shareholders, or 2019 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 2019 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 2019 Annual Meeting and Nominations for Director,” “Section 16(a) Beneficial Ownership Reporting Compliance” and “Code of Conduct.” The information regarding executive officers required by this Item 10 as well as certain information regarding our directors 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 2019 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 2019 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 2019 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 2019 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:

(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
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.		10-Q (Exhibit 3.2)	July 26, 2018	000-19319
4.1	Specimen stock certificate.		10-K (Exhibit 4.1)	February 15, 2018	000-19319
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/A (Exhibit 10.2)	August 19, 2011	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-K (Exhibit 10.9)	March 16, 2006	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)	August 9, 2011	000-19319
10.5			10-K		000-19319

	Amendment No. 7 to Research, Development and Commercialization Agreement, dated October 13, 2016, between Vertex Pharmaceuticals Incorporated and Cystic Fibrosis Foundation Therapeutics Incorporated. †	(Exhibit 10.05)	February 23, 2017	
Leases				
10.6	Lease, dated May 5, 2011, between Fifty Northern Avenue LLC and Vertex Pharmaceuticals Incorporated.†	10-Q (Exhibit 10.4)	August 9, 2011	000-19319
10.7	Lease, dated May 5, 2011, between Eleven Fan Pier Boulevard LLC and Vertex Pharmaceuticals Incorporated.†	10-Q (Exhibit 10.5)	August 9, 2011	000-19319
10.8	Lease, dated December 2, 2015, between ARE-SD Region No. 23, LLC and Vertex Pharmaceuticals Incorporated.	10-K (Exhibit 10.10)	February 16, 2016	000-19319
10.9	First Amendment to Lease, dated as of March 1, 2017, between ARE-SD Region No. 23 and Vertex Pharmaceuticals Incorporated.	10-Q (Exhibit 10.3)	April 28, 2017	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
Financing Agreements					
10.10	Credit Agreement, dated as of October 13, 2016, among Vertex Pharmaceuticals Incorporated, Bank of America, N.A. and the other lenders party thereto.		10-K (Exhibit 10.12)	February 23, 2017	000-19319
10.11	First Amendment to Credit Agreement, dated as of February 9, 2017, among Vertex Pharmaceuticals Incorporated, Bank of America, N.A. and the other lenders party thereto.		10-K (Exhibit 10.13)	February 23, 2017	000-19319
Equity Plans					
10.12	Amended and Restated 2006 Stock and Option Plan.*		10-Q (Exhibit 10.1)	October 25, 2018	000-19319
10.13	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
10.14	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
10.15	Amended and Restated 2013 Stock and Option Plan.*		10-Q (Exhibit 10.2)	October 25, 2018	000-19319
10.16	Form of Non-Qualified Stock Option Agreement under 2013 Stock and Option Plan.*		10-K (Exhibit 10.17)	February 13, 2015	000-19319
10.17	Form of Restricted Stock Agreement under 2013 Stock and Option Plan.*		10-K (Exhibit 10.18)	February 13, 2015	000-19319
10.18	Form of Restricted Stock Unit Agreement under 2013 Stock and Option Plan (U.S.).*		10-K (Exhibit 10.25)	February 16, 2016	000-19319
10.19	Form of Restricted Stock Unit Agreement under 2013 Stock and Option Plan (International).*		10-K (Exhibit 10.19)	February 13, 2015	000-19319
10.20	Non-Employee Director Deferred Compensation Plan.*		10-K (Exhibit 10.27)	February 16, 2016	000-19319
10.21	Vertex Pharmaceuticals Incorporated Employee Stock Purchase Plan, as amended and restated as of July 12, 2016.*		10-Q (Exhibit 10.1)	August 1, 2016	000-19319
Agreements with Executive Officers and Directors					
10.22	Amended and Restated Employment Agreement, dated November 30, 2016, by and between Vertex Pharmaceuticals Incorporated and Jeffrey M. Leiden, M.D., Ph.D*		8-K (Exhibit 10.1)	December 2, 2016	000-19319
10.23	Employee Non-disclosure, Non-competition and Inventions Agreement between Jeffrey M. Leiden and Vertex, dated December 14, 2011.*		10-K (Exhibit 10.35)	February 22, 2012	000-19319
10.24	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
10.25			10-Q		000-19319

	Change of Control Agreement, dated as of August 27, 2012, between Vertex Pharmaceuticals Incorporated and Stuart Arbuckle.*	(Exhibit 10.2)	November 6, 2012	
10.26	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
10.27	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
10.28	Amended and Restated Employment Agreement, dated as of November 8, 2004, between Vertex Pharmaceuticals Incorporated and Ian F. Smith.*	10-Q (Exhibit 10.13)	November 9, 2004	000-19319
10.29	Amendment No. 1 to Amended and Restated Employment Agreement between Ian F. Smith and Vertex Pharmaceuticals Incorporated, dated December 29, 2008.*	10-K (Exhibit 10.66)	February 17, 2009	000-19319
10.32	Employment Agreement, dated as of November 14, 2015, between Vertex Pharmaceuticals Incorporated and Michael Parini.*	10-K (Exhibit 10.40)	February 23, 2017	000-19319
10.33	Change of Control Agreement, dated as of November 9, 2015, between Vertex Pharmaceuticals Incorporated and Michael Parini.*	10-K (Exhibit 10.41)	February 23, 2017	000-19319
10.34	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
10.35	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
10.36	Employment Agreement, dated as of September 6, 2017, between Vertex Pharmaceuticals Incorporated and Tom Graney.*	10-Q (Exhibit 10.1)	October 30, 2017	000-19319
10.37	Change of Control Agreement, dated as of September 6, 2017, between Vertex Pharmaceuticals Incorporated and Tom Graney.*	10-Q (Exhibit 10.2)	October 30, 2017	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
10.38	Vertex Employee Compensation Plan.*		10-K (Exhibit 10.46)	February 15, 2018	000-19319
10.39	Vertex Pharmaceuticals Non-Employee Board Compensation.*	X			
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			

* Management contract, compensatory plan or agreement.

† Confidential portions of this document have been filed separately with the Securities and Exchange Commission pursuant to a request for confidential treatment.

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 13, 2019 By: /s/ Jeffrey M. Leiden
Jeffrey M. Leiden
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/ Jeffrey M. Leiden Jeffrey M. Leiden	Chair of the Board, President and Chief Executive Officer (Principal Executive Officer)	February 13, 2019
/s/ Paul M. Silva Paul M. Silva	Senior Vice President, Corporate Controller and Interim Chief Financial Officer (Principal Accounting Officer and Principal Financial Officer)	February 13, 2019
/s/ Sangeeta N. Bhatia Sangeeta N.	Director	February 13, 2019

Bhatia		
/s/ Alan Garber Alan Garber	Director	February 13, 2019
/s/ Terrence C. Kearney Terrence C. Kearney	Director	February 13, 2019
/s/ Yuchun Lee Yuchun Lee	Director	February 13, 2019
/s/ Margaret G. McGlynn Margaret G. McGlynn	Director	February 13, 2019
/s/ Bruce I. Sachs Bruce I. Sachs	Director	February 13, 2019
/s/ Elaine S. Ullian Elaine S. Ullian	Director	February 13, 2019
/s/ William D. Young William D. Young	Director	February 13, 2019

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Item 16. FORM 10-K SUMMARY
Not applicable.

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, 2018 and 2017, the related consolidated statements of operations, comprehensive income (loss), shareholders' equity and noncontrolling interest, and cash flows for each of the three years in the period ended December 31, 2018, and the related notes (collectively referred to as the "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, 2018 and 2017, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2018, in conformity with 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, 2018, 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 13, 2019 expressed an unqualified opinion thereon.

Adoption of New Accounting Standards

ASU No. 2014-09

As discussed in Note A to the consolidated financial statements, the Company changed its method for recognizing revenue as a result of the adoption of Accounting Standard Update (ASU) No. 2014-09, Revenue from Contracts with Customers (Topic 606), and the amendments in ASUs 2015-14, 2016-08, 2016-10 and 2016-12 effective January 1, 2018.

ASU No. 2016-18

As discussed in Note A to the consolidated financial statements, on January 1, 2018, the Company retrospectively changed its method of presenting changes in restricted cash in the accompanying consolidated statements of cash flows as a result of the adoption of ASU No. 2016-18, Statement of Cash Flows (Topic 230): Restricted Cash.

ASU No. 2016-01

As discussed in Note A to the consolidated financial statements, on January 1, 2018, the Company changed its method of presenting changes in the fair value of its investments in corporate equity securities as a result of the adoption of ASU No. 2016-01, Financial Instruments (Subtopic 825-10): Recognition and Measurement of Financial Assets and Financial Liabilities.

ASU No. 2016-16

As discussed in Note A to the consolidated financial statements, on January 1, 2018, the Company changed its method for recognizing current and deferred income tax expenses or benefits related to the transfer of assets, other than inventory, within the consolidated entity as a result of the adoption of ASU No. 2016-16, Income Taxes (Topic 740): Intra-Entity Transfers of Assets Other Than Inventory.

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

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evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ Ernst & Young LLP

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

Boston, Massachusetts

February 13, 2019

VERTEX PHARMACEUTICALS INCORPORATED
Consolidated Statements of Operations
(in thousands, except per share amounts)

	Year Ended December 31,		
	2018	2017	2016
Revenues:			
Product revenues, net	$3,038,325	$2,165,480	$1,683,632
Collaborative and royalty revenues	9,272	323,172	18,545
Total revenues	3,047,597	2,488,652	1,702,177
Costs and expenses:			
Cost of sales	409,539	275,119	210,460
Research and development expenses	1,416,476	1,324,625	1,047,690
Sales, general and administrative expenses	557,616	496,079	432,829
Restructuring (income) expenses	(184)	14,246	1,262
Intangible asset impairment charges	29,000	255,340	—
Total costs and expenses	2,412,447	2,365,409	1,692,241
Income from operations	635,150	123,243	9,936
Interest expense, net	(34,119)	(57,550)	(81,432)
Other (expense) income, net	(790)	(81,382)	4,130
Income (loss) before (benefit from) provision for income taxes	600,241	(15,689)	(67,366)
(Benefit from) provision for income taxes	(1,486,862)	(107,324)	16,665
Net income (loss)	2,087,103	91,635	(84,031)
Loss (income) attributable to noncontrolling interest	9,793	171,849	(28,021)
Net income (loss) attributable to Vertex	$2,096,896	$263,484	$(112,052)
Amounts per share attributable to Vertex common shareholders:			
Net income (loss):			
Basic	$8.24	$1.06	$(0.46)
Diluted	$8.09	$1.04	$(0.46)
Shares used in per share calculations:			
Basic	254,292	248,858	244,685
Diluted	259,185	253,225	244,685

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

VERTEX PHARMACEUTICALS INCORPORATED
Consolidated Statements of Comprehensive Income (Loss)
(in thousands)

	Year ended December 31,		
	2018	2017	2016
Net income (loss)	$2,087,103	$91,635	$(84,031)
Changes in other comprehensive income (loss):			
Unrealized holding gains on marketable securities, net of tax of zero, $(2.7) million and $(3.8) million, respectively	58	6,954	17,395
Unrealized gains (losses) on foreign currency forward contracts, net of tax of $(7.1) million, $3.4 million and $(3.9) million, respectively	27,438	(26,530)	7,736
Foreign currency translation adjustment	8,855	(13,169)	(5,782)
Total changes in other comprehensive income (loss)	36,351	(32,745)	19,349
Comprehensive income (loss)	2,123,454	58,890	(64,682)
Comprehensive loss (income) attributable to noncontrolling interest	9,793	171,849	(28,021)
Comprehensive income (loss) attributable to Vertex	$2,133,247	$230,739	$(92,703)

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

VERTEX PHARMACEUTICALS INCORPORATED
Consolidated Balance Sheets
(in thousands, except share and per share amounts)

	December 31,	
	2018	2017
Assets		
Current assets:		
Cash and cash equivalents	$2,650,134	$1,665,412
Marketable securities	518,108	423,254
Accounts receivable, net	409,688	281,343
Inventories	124,360	111,830
Prepaid expenses and other current assets	140,819	167,124
Total current assets	3,843,109	2,648,963
Property and equipment, net	812,005	789,437
Intangible assets	—	29,000
Goodwill	50,384	50,384
Deferred tax assets	1,499,672	834
Other assets	40,728	27,396
Total assets	$6,245,898	$3,546,014
Liabilities and Shareholders' Equity		
Current liabilities:		
Accounts payable	$110,987	$73,994
Accrued expenses	604,495	443,961
Capital lease obligations, current portion	9,817	22,531
Early access sales accrual	354,404	232,401
Other liabilities, current portion	40,589	34,373
Total current liabilities	1,120,292	807,260
Capital lease obligations, excluding current portion	19,658	20,496
Deferred tax liabilities	—	6,341
Construction financing lease obligation, excluding current portion	561,892	563,406
Advance from collaborator, excluding current portion	82,573	78,431
Other liabilities, excluding current portion	26,280	27,774
Total liabilities	1,810,695	1,503,708
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, 255,172,328 and 253,253,362 shares issued and outstanding, respectively	2,546	2,512
Additional paid-in capital	7,421,476	7,157,362
Accumulated other comprehensive income (loss)	659	(11,572)
Accumulated deficit	(2,989,478)	(5,119,723)
Total Vertex shareholders' equity	4,435,203	2,028,579
Noncontrolling interest	—	13,727
Total shareholders' equity	4,435,203	2,042,306
Total liabilities and shareholders' equity	$6,245,898	$3,546,014

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

VERTEX PHARMACEUTICALS INCORPORATED
Consolidated Statements of Shareholders' Equity and Noncontrolling Interest
(in thousands)

	Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive Income (Loss)	Accumulated Deficit	Total Vertex Shareholders' Equity	Noncontrolling Interest	Total Shareholders' Equity
	Shares	Amount						
Balance, December 31, 2015	246,307	$2,427	$6,197,500	$ 1,824	$(5,261,784)	$939,967	$ 153,661	$1,093,628
Other comprehensive income, net of tax	—	—	—	19,349	—	19,349	—	19,349
Net (loss) income	—	—	—	—	(112,052)	(112,052)	28,021	(84,031)
Issuance of common stock under benefit plans	1,994	23	67,983	—	—	68,006	—	68,006
Stock-based compensation expense	—	—	241,312	—	—	241,312	(73)	241,239
Balance, December 31, 2016	248,301	$2,450	$6,506,795	$ 21,173	$(5,373,836)	$1,156,582	$ 181,609	$1,338,191
Cumulative effect adjustment for adoption of new accounting guidance	—	—	9,371	—	(9,371)	—	—	—
Other comprehensive loss, net of tax	—	—	—	(32,745)	—	(32,745)	—	(32,745)
Net income (loss)	—	—	—	—	263,484	263,484	(171,849)	91,635
Issuance of common stock under benefit plans	4,952	62	345,554	—	—	345,616	57	345,673
Stock-based compensation expense	—	—	295,642	—	—	295,642	—	295,642
VIE noncontrolling interest upon deconsolidation	—	—	—	—	—	—	3,910	3,910
Balance, December 31, 2017	253,253	$2,512	$7,157,362	$ (11,572)	$(5,119,723)	$2,028,579	$ 13,727	$2,042,306
	—	—	—	(24,120)	33,349	9,229	—	9,229

Cumulative effect adjustment for adoption of new accounting guidance								
Other comprehensive income, net of tax	—	—	—	36,351	—	36,351	—	36,351
Net income (loss)	—	—	—	—	2,096,896	2,096,896	(9,793)	2,087,103
Repurchases of common stock	(2,094)	(21)	(350,022)	—	—	(350,043)	—	(350,043)
Issuance of common stock under benefit plans	4,013	55	288,480	—	—	288,535	—	288,535
Stock-based compensation expense	—	—	325,656	—	—	325,656	—	325,656
VIE noncontrolling interest upon deconsolidation	—	—	—	—	—	—	(3,540)	(3,540)
Other VIE activity	—	—	—	—	—	—	(394)	(394)
Balance, December 31, 2018	255,172	$2,546	$7,421,476	$659	$(2,989,478)	$4,435,203	$—	$4,435,203

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

VERTEX PHARMACEUTICALS INCORPORATED
Consolidated Statements of Cash Flows
(in thousands)

	Year Ended December 31,		
	2018	2017	2016
Cash flows from operating activities:			
Net income (loss)	$2,087,103	$91,635	$(84,031)
Adjustments to reconcile net income (loss) to net cash provided by operating activities:			
Stock-based compensation expense	325,047	293,236	240,623
Depreciation expense	72,420	61,397	61,398
Write-downs of inventories to net realizable value	20,413	15,292	—
Deferred income taxes (including benefit from valuation allowance release)	(1,512,325)	(120,513)	16,961
Unrealized gain on equity securities	(2,558)	—	—
Intangible asset impairment charges	29,000	255,340	—
Acquired in-process research and development	—	160,000	—
Deconsolidation of VIE	1,077	76,644	—
Other non-cash items, net	12,089	(853)	6,140
Changes in operating assets and liabilities:			
Accounts receivable, net	(108,152)	(71,759)	(39,095)
Inventories	(31,965)	(47,484)	(19,368)
Prepaid expenses and other assets	16,684	(111,063)	(2,631)
Accounts payable	36,554	8,753	(11,745)
Accrued expenses and other liabilities	195,623	75,332	(5,565)
Early access sales accrual	129,276	158,985	73,416
Net cash provided by operating activities	1,270,286	844,942	236,103
Cash flows from investing activities:			
Maturities of available-for-sale debt securities	431,576	369,214	757,562
Purchases of available-for-sale debt securities	(431,918)	(532,581)	(616,625)
Expenditures for property and equipment	(95,524)	(99,421)	(56,563)
Purchase of in-process research and development	—	(160,000)	—
Investment in note receivable	(15,000)	—	(20,000)
Investment in equity securities	(83,471)	—	(13,075)
Decrease in restricted cash due to deconsolidation of VIE	(7,896)	(61,602)	—
Other investing activities	75	1,061	(61)
Net cash used in (provided by) investing activities	(202,158)	(483,329)	51,238
Cash flows from financing activities:			
Issuances of common stock under benefit plans	289,293	344,840	68,230
Repurchase of common stock	(350,043)	—	—
Payments on revolving credit facility	—	(300,000)	—
Advance from collaborator	7,500	12,500	75,000
Payments related to construction financing lease obligation	(5,462)	(541)	(432)
Proceeds related to construction financing lease obligation	9,566	27,182	—
Proceeds from capital lease financing	11,274	7,484	11,208
Payments on capital lease obligations	(27,926)	(18,795)	(17,597)
Repayments of advanced funding	(5,027)	(4,266)	—
Payments on senior secured term loan	—	—	(75,000)
Proceeds from revolving credit facility	—	—	74,965
Payments of debt issuance costs	—	—	(3,103)

Other financing activities	(394)	—	—
Net cash (used in) provided by financing activities	(71,219)	68,404	133,271
Effect of changes in exchange rates on cash	(6,182)	5,802	(4,666)
Net increase in cash, cash equivalents and restricted cash	990,727	435,819	415,946
Cash, cash equivalents and restricted cash—beginning of period	1,667,526	1,231,707	815,761
Cash, cash equivalents and restricted cash—end of period	$2,658,253	$1,667,526	$1,231,707
Supplemental disclosure of cash flow information:			
Cash paid for interest	$66,458	$68,696	$83,656
Cash paid for (received from) income taxes	$12,402	$6,414	$(2,579)
Non-cash investing and financing activities:			
Capitalization of costs related to construction financing lease obligation	$3,389	$40,855	$14,238
Issuances of common stock from employee benefit plans receivable	$86	$844	$68
Proceeds from revolving credit facility directly paid to settle all outstanding obligations under the term loan	$—	$—	$225,000

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

VERTEX PHARMACEUTICALS INCORPORATED
Notes to Consolidated Financial Statements
A. Nature of Business and Accounting Policies
Business
Vertex Pharmaceuticals Incorporated ("Vertex" or the "Company") invests in scientific innovation to create transformative medicines for serious diseases. The Company's business is focused on developing and commercializing therapies for the treatment of cystic fibrosis ("CF") and advancing research and development programs in other indications. The Company's marketed products are SYMDEKO/SYMKEVI (tezacaftor in combination with ivacaftor), ORKAMBI (lumacaftor in combination with ivacaftor) and KALYDECO (ivacaftor), which are approved to treat patients with CF who have specific mutations in their cystic fibrosis transmembrane conductance regulator ("CFTR") gene.
As of December 31, 2018, the Company had cash, cash equivalents and marketable securities of $3.2 billion. The Company expects that cash flows from the sales of its products, together with the Company's cash, cash equivalents and marketable securities, will be sufficient to fund its operations for at least the next twelve months.
Vertex is subject to risks common to companies in its industry including, but not limited to, the dependence on revenues from its CF products, competition, uncertainty about clinical trial outcomes and regulatory approvals, uncertainties relating to pharmaceutical pricing and reimbursement, uncertainty related to international expansion, uncertain protection of proprietary technology, the need to comply with government regulations, share price volatility, dependence on collaborative relationships and potential product liability.
Basis of Presentation
The consolidated financial statements reflect the operations of (i) the Company, (ii) its wholly-owned subsidiaries and (iii) consolidated variable interest entities ("VIEs"). As of September 30, 2017, the Company deconsolidated Parion Sciences, Inc. ("Parion"), a VIE the Company had consolidated since 2015. As of December 31, 2018, the Company deconsolidated BioAxone Biosciences, Inc. ("BioAxone"), a VIE the Company had consolidated since 2014. As of December 31, 2018, the Company does not have any consolidated VIEs. All material intercompany balances and transactions have been eliminated. The Company operates in one segment, pharmaceuticals. Please refer to Note R, "Segment Information," for enterprise-wide disclosures regarding the Company's revenues, major customers and long-lived assets by geographic area. The Company has reclassified certain items from the prior year's consolidated financial statements to conform to the current year's presentation.
Use of Estimates
The preparation of consolidated financial statements in accordance with accounting principles generally accepted in the United States of America ("GAAP") requires management 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 the consolidated financial statements, and the amounts of revenues and expenses during the reported periods. Significant estimates in these consolidated financial statements have been made in connection with the calculation of revenues, research and development expenses, the fair value of intangible assets, goodwill, noncontrolling interest, the consolidation and deconsolidation of VIEs, deferred tax asset valuation allowances and the provision for or benefit from income taxes. The Company bases its estimates on historical experience and various other assumptions, including in certain circumstances future projections, that management believes 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.

VERTEX PHARMACEUTICALS INCORPORATED
Notes to Consolidated Financial Statements (Continued)

Revenue Recognition

Pursuant to Accounting Standards Codification ("ASC") 606, Revenue from Contracts with Customers ("ASC 606"), the Company recognizes revenue when a customer obtains control of promised goods or services. The Company records the amount of revenue that reflects the consideration that it expects to receive in exchange for those goods or services. The Company applies the following five-step model in order 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) the Company satisfies each performance obligation.

The Company only applies the five-step model to contracts when it is probable that it will collect the consideration to which it is entitled in exchange for the goods or services that it transfers to the customer. Once a contract is determined to be within the scope of ASC 606 at contract inception, the Company reviews the contract to determine which performance obligations it must deliver and which of these performance obligations are distinct. The Company recognizes 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, the Company's performance obligations are transferred to customers at a point in time, typically upon delivery.

Product Revenues, Net

The Company sells its products principally to a limited number of specialty pharmacy and specialty distributors in the United States, which account for the largest portion of its total revenues, and makes international sales primarily to specialty distributors and retail chains, as well as hospitals and clinics, many of which are government-owned or supported (collectively, its "Customers"). The Company's Customers in the United States subsequently resell the products to patients and health care providers. In accordance with ASC 606, the Company recognizes net revenues from product sales when the Customers obtain control of the Company's products, which typically occurs upon delivery to the Customer. The Company's payment terms are approximately 30 days in the United States 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, the Company utilizes the expected value method to determine the appropriate amount for estimates of variable consideration based on factors such as the Company's 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 the Company's estimates. If actual results vary from the Company's estimates, the Company adjusts these estimates, which would affect net product revenue and earnings in the period such variances become known.

Invoice Discounts and Distribution Fees: The Company generally provides invoice discounts on product sales to its Customers for prompt payment and pays fees for distribution services, such as fees for certain data that Customers provide to the Company. The Company estimates that, based on its experience, its Customers will earn these discounts and fees, and deducts the full amount of these discounts and fees from its gross product revenues and accounts receivable at the time such revenues are recognized.

Rebates, Chargebacks, Discounts and Fees: The Company contracts with government agencies (its "Third-party Payors") so that products will be eligible for purchase by, or partial or full reimbursement from, such Third-party Payors. The Company estimates the rebates, chargebacks, discounts and fees it will provide to Third-party Payors and deducts

these estimated amounts from its gross product revenues at the time the revenues are recognized. For each product, the Company estimates the aggregate rebates, chargebacks and discounts that it will provide to Third-party Payors based upon (i) the Company's contracts with these Third-party Payors, (ii) the government-mandated discounts and fees applicable to government-funded programs, (iii) information obtained from the Company's Customers and other third-party data regarding the payor mix for such product and (iv) historical experience.

Other Incentives: Other incentives that the Company offers include co-pay mitigation rebates provided by the Company to commercially insured patients who have coverage and who reside in states that permit co-pay mitigation programs. Based upon the terms of the Company's co-pay mitigation programs, the Company estimates average co-pay mitigation amounts for each of its products in order to establish appropriate accruals.

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

The Company excludes taxes collected from Customers relating to product sales and remitted to governmental authorities from revenues.

Contract Liabilities

The Company's contract liabilities relate to annual contracts with government-owned and supported customers in international markets that limit the amount of annual reimbursement the Company can receive. Upon exceeding the annual reimbursement amount, products are provided free of charge, which is a material right pursuant to ASC 606. These contracts, which are classified as "Other liabilities, current portion," include upfront payments and fees. The Company defers a portion of the consideration received for shipments made up to the annual reimbursement limit, and the deferred amount is recognized as revenue when the free products are shipped. The Company's product revenue contracts include performance obligations that are one year or less.

The Company's contract liabilities of $24.9 million and $1.7 million as of December 31, 2018 and 2017, respectively, represent balances related to contracts with annual reimbursement limits in several international markets in which the annual period associated with the contract is not the same as the Company's fiscal year. In the majority of international markets in which the Company has a contract with an annual reimbursement limit, the annual period associated with the contract is the same as the Company's fiscal year, resulting in no contract liability balance at the end of the year and no revenues recognized in the current year related to performance obligations satisfied in previous periods. For the international markets in which the periods associated with these annual contracts are not the same as the Company's fiscal year, the Company recognizes revenues related to performance obligations satisfied in previous years; however, these amounts are not material to the Company's financial statements and do not relate to any performance obligations that were satisfied more than 12 months prior to the beginning of the current year. The revenues recognized in the year ended December 31, 2018 related to performance obligations satisfied in the prior year were $1.7 million.

French Early Access Programs

Pursuant to ASC 605, Revenue Recognition ("ASC 605"), which was applicable until December 31, 2017, the Company only recognized revenues from product sales if it determined that the price was fixed or determinable at the time of delivery. If the Company determined that the price was not fixed or determinable, it deferred the recognition of revenues. If the Company was able to determine that the price was fixed or determinable, it recognized the net product revenues associated with the units.

The Company began distributing ORKAMBI through early access programs in France during the fourth quarter of 2015 and is engaged in ongoing pricing discussions regarding the final price for ORKAMBI in France. The Company's ORKAMBI net product revenues for 2017, 2016 and 2015 did not include any net product revenues from sales of

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in France because the price was not fixed or determinable. The Company expects that the difference between the amounts collected based on the invoiced price and the final price for ORKAMBI in France will be returned to the French government.

As of December 31, 2018 and 2017, the Company's consolidated balance sheets included $354.4 million and $232.4 million, respectively, classified as "Early access sales accrual" related to amounts collected in France as payment for shipments of ORKAMBI under the early access programs, which is considered to be a refund liability pursuant to ASC 606.

Upon adopting ASC 606 in 2018, the Company recorded an $8.3 million cumulative effect adjustment to "Accumulated deficit" primarily related to shipments of ORKAMBI under the early access programs in France. The Company determined the amount of the adjustment based upon (i) the status of pricing discussions in France upon adoption, (ii) its estimate of the amount of consideration it expects to retain related to ORKAMBI sales in France that occurred on or prior to December 31, 2017 that will not be subject to a significant reversal in amounts recognized and (iii) recognition of costs previously deferred related to the ORKAMBI sales in France. For ORKAMBI sales in France that occurred after December 31, 2017 under the early access programs, the Company has recognized net product revenues based on the estimate of consideration it expects to retain that will not be subject to a significant reversal in amounts recognized. If the Company's estimate regarding the amounts it will receive for ORKAMBI supplied pursuant to these early access programs changes, it will reflect the effect of the change in estimate in net product revenues in the period in which the change in estimate occurs and will include adjustments to all prior sales of ORKAMBI under the early access programs. Please refer to Recent Accounting Pronouncements included in this Note A, "Nature of Business and Accounting Policies," below for more information regarding the revenue recognition guidance adopted as of January 1, 2018.

Collaborative and Royalty Revenues

The Company recognizes collaborative revenues generated through collaborative research, development and/or commercialization agreements. The terms of these agreements typically include payment to the Company related to one or more of the following: nonrefundable, upfront license fees; development and commercial milestones; funding of research and/or development activities; and royalties on net sales of licensed products. Revenue is recognized upon satisfaction of a performance obligation by transferring control of a good or service to the collaborator.

For each collaborative research, development and/or commercialization agreement that results in revenue, the Company identifies all material performance obligations, which may include a license to intellectual property and know-how, research and development activities and/or transition activities. In order to determine the transaction price, in addition to any upfront payment, the Company estimates the amount of variable consideration at the outset of the contract either utilizing the expected value or most likely amount method, depending on the facts and circumstances relative to the contract. The Company constrains (reduces) the estimate of variable consideration such that it is probable that a significant reversal of previously recognized revenue will not occur throughout the life of the contract. When determining if variable consideration should be constrained, management considers whether there are factors outside the Company's control that could result in a significant reversal of revenue. In making these assessments, the Company considers the likelihood and magnitude of a potential reversal of revenue. These estimates are re-assessed each reporting period as required.

Once the estimated transaction price is established, amounts are allocated to the performance obligations that have been identified. The transaction price is generally allocated to each separate performance obligation on a relative standalone selling price basis. In order to account for these agreements, the Company must develop assumptions that require judgment to determine the standalone selling price, which may include (i) the probability of obtaining marketing approval for the drug candidate, (ii) estimates regarding the timing of and the expected costs to develop and commercialize the drug candidate, (iii) estimates of future cash flows from potential product sales with respect to the drug candidate and (iv) appropriate discount and tax rates. Standalone selling prices used to perform the initial allocation are not updated after contract inception. The Company does not include a financing component to its

estimated transaction price at contract inception unless it estimates that certain performance obligations will not be satisfied within one year.

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Notes to Consolidated Financial Statements (Continued)

Upfront License Fees: If a license to the Company's intellectual property is determined to be distinct from the other performance obligations identified in an arrangement, the Company recognizes revenue from the related nonrefundable, upfront license fees based on the relative standalone selling price prescribed to the license compared to the total selling price of the arrangement. The revenue is recognized when the license is transferred to the collaborator and the collaborator is able to use and benefit from the license. For licenses that are not distinct from other obligations identified in the arrangement, the Company utilizes judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time. If the combined performance obligation is satisfied over time, the Company applies an appropriate method of measuring progress for purposes of recognizing revenue from nonrefundable, upfront license fees. The Company evaluates the measure of progress each reporting period and, if necessary, adjusts the measure of performance and related revenue recognition.

Development and Regulatory Milestone Payments: Depending on facts and circumstances, the Company may conclude that it is appropriate to include certain milestones in the estimated transaction price or that it is appropriate to fully constrain the milestones. A milestone payment is included in the transaction price in the reporting period that the Company concludes that it is probable that recording revenue in the period will not result in a significant reversal in amounts recognized in future periods. The Company may record revenues from certain milestones in a reporting period before the milestone is achieved if the Company concludes that achievement of the milestone is probable and that recognition of revenue related to the milestone will not result in a significant reversal in amounts recognized in future periods. The Company records a corresponding contract asset when this conclusion is reached. Milestone payments that have not been included in the transaction price to date are fully constrained. These milestones remain fully constrained until the Company concludes that their achievement is probable and that recognition of the related revenue will not result in a significant reversal in amounts recognized in future periods. The Company re-evaluates the probability of achievement of such development milestones and any related constraint each reporting period and adjusts its estimate of the overall transaction price, including the amount of collaborative revenue that it has recorded, if necessary.

Research and Development Activities/Transition Services: If the Company is entitled to reimbursement from its collaborators for specified research and development expenses, it accounts for the related services that it provides as separate performance obligations if it determines that these services represent a material right. The Company also determines whether the reimbursement of research and development expenses should be accounted for as collaborative revenues or an offset to research and development expenses in accordance with the provisions of gross or net revenue presentation. The Company recognizes the corresponding revenues or records the corresponding offset to research and development expenses as it satisfies the related performance obligations.

Sales-based Milestone and Royalty Payments: The Company's collaborators may be required to pay the Company sales-based milestones or royalties on future sales of commercial products. The Company recognizes revenues related to sales-based milestone and royalties upon the later to occur of (i) achievement of the collaborator's underlying sales or (ii) satisfaction of any performance obligation(s) related to these sales, in each case assuming the license to the Company's intellectual property is deemed to be the predominant item to which the sales-based milestones and/or royalties relate.

Concentration of Credit Risk

Financial instruments that potentially subject the Company to concentration of credit risk consist principally of money market funds and marketable securities. The Company places these investments with highly rated financial institutions, and, by policy, limits the amounts of credit exposure to any one financial institution. These amounts at times may exceed federally insured limits. The Company also maintains a foreign currency hedging program that includes foreign currency forward contracts with several counterparties. The Company has not experienced any credit losses related to these financial instruments and does not believe it is exposed to any significant credit risk related to these instruments.

The Company also is subject to credit risk from its accounts receivable related to its product sales and collaborators. The Company evaluates the creditworthiness of each of its customers and has determined that all of its material customers are creditworthy. To date, the Company has not experienced significant losses with respect to the collection of its accounts receivable. The Company's receivables from Greece, Italy, Portugal and Spain were not material as of December 31, 2018.

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Notes to Consolidated Financial Statements (Continued)

The Company believes that its allowance for doubtful accounts was adequate at December 31, 2018. Please refer to Note R, "Segment Information," for further information.

Cash and Cash Equivalents

The Company considers 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, 2018, the Company's marketable securities consisted of investments in available-for-sale debt securities, including U.S. Treasury securities, government-sponsored enterprise securities, corporate debt securities and commercial paper, and corporate equity securities with readily determinable fair values. The Company classifies marketable securities available to fund current operations as current assets on its consolidated balance sheets. Marketable securities are classified as long-term assets on the consolidated balance sheets if (i) they have been in an unrealized loss position for longer than one year and (ii) the Company has the ability and intent to hold them (a) until the carrying value is recovered and (b) such holding period may be longer than one year. The Company's marketable securities are stated at fair value. The fair value of these securities is based on quoted prices for identical or similar assets.

The Company records unrealized gains (losses) on available-for-sale debt securities as a component of "Accumulated other comprehensive income (loss)," which is a separate component of shareholders' equity on its consolidated balance sheet, until such gains and losses are realized.

Pursuant to the adoption of Accounting Standards Update ("ASU") No. 2016-01, Recognition and Measurement of Financial Assets and Financial Liabilities ("ASU 2016-01") on January 1, 2018, the Company began recording changes in the fair value of its investments in corporate equity securities to "Other (expense) income, net" in the Company's consolidated statements of operations. Prior to its adoption of ASU 2016-01 in 2018, the Company recorded changes in the fair value of its investments in corporate equity securities to "Accumulated other comprehensive income (loss)."

The Company reviews investments in marketable debt securities for other-than-temporary impairment whenever the fair value of an investment is less than the amortized cost and evidence indicates that an investment's carrying amount is not recoverable within a reasonable period of time. To determine whether an impairment is other-than-temporary, the Company considers whether it has an intent to sell, or whether it is more likely than not that the Company will be required to sell, the investment before recovery of the investment's amortized cost basis. Evidence considered in this assessment includes reasons for the impairment, compliance with the Company's investment policy, the severity and the duration of the impairment and changes in value subsequent to year-end. If a decline in the fair value is considered other-than-temporary, based on available evidence, the unrealized loss is transferred from other comprehensive income (loss) to the consolidated statements of operations.

Realized gains and losses are determined using the specific identification method and are included in "Other (expense) income, net" in the consolidated statements of operations.

Accounts Receivable

The Company deducts invoice discounts for prompt payment and fees for distribution services from its accounts receivable based on its experience that the Company's Customers will earn these discounts and fees. The Company's estimates for its allowance for doubtful accounts, which have not been significant to date, are determined based on existing contractual payment terms and historical payment patterns.

Stock-based Compensation Expense

The Company expenses the fair value of employee stock options 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.

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Notes to Consolidated Financial Statements (Continued)

For awards with performance conditions in which the award does not vest unless the performance condition is met, the Company recognizes expense if, and to the extent that, the Company estimates that achievement of the performance condition is probable. If the Company concludes that vesting is probable, it recognizes expense from the date it reaches this conclusion through the estimated vesting date. For awards with performance conditions that accelerate vesting of the award, the Company estimates the likelihood of satisfaction of the performance conditions, which affects the period over which the expense is recognized, and recognizes the expense using the accelerated attribution model.

The Company provides to employees who have rendered a certain number of years' to the Company 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. Less than 5% of the Company's employees were eligible for partial or full acceleration of any of their equity awards as of December 31, 2018. The Company recognizes stock-based compensation expense related to these awards over a service period reflecting qualified employees' eligibility for partial or full acceleration of vesting.

Research and Development Expenses

The Company expenses as incurred all research and development expenses, including amounts funded by research and development collaborations. The Company capitalizes nonrefundable advance payments made by the Company for research and development activities and expenses the payments as the related goods are delivered or the related services are performed.

Research and development expenses are comprised of costs incurred by the Company in performing research and development activities, including salary and benefits; stock-based compensation expense; laboratory supplies and other direct expenses; outsourced services, including clinical trial and pharmaceutical development costs; collaboration and asset acquisition payments; expenses associated with drug supplies that are not being capitalized; and infrastructure costs, including facilities costs and depreciation expense.

Advertising Expenses

The Company expenses the costs of advertising, including promotional expenses, as incurred. Advertising expenses, recorded in sales, general and administrative expenses, were $43.5 million, $35.2 million and $31.4 million in 2018, 2017 and 2016, respectively.

Inventories

The Company values its inventories at the lower-of-cost or net realizable value. The Company determines the cost of its inventories, which includes amounts related to materials and manufacturing overhead, on a first-in, first-out basis. The Company performs an assessment of the recoverability of capitalized inventory during each reporting period, and writes 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 the consolidated statements of operations. Shipping and handling costs incurred for product shipments are recorded as incurred in "Cost of sales" in the consolidated statements of operations.

The Company capitalizes inventories produced in preparation for initiating sales of a drug candidate when the related drug 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 or not to capitalize such inventories, the Company evaluates, among other factors, information regarding the drug 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, the Company evaluates risks associated with manufacturing the drug candidate and the remaining shelf-life of the inventories.

Property and Equipment

Property and equipment are recorded at cost. Depreciation expense is recorded using the straight-line method over the estimated useful life of the related asset, generally seven to ten years for furniture and equipment, three to five years

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computers and software, 40 years for buildings and for leasehold improvements, the shorter of the useful life of the improvements or the estimated remaining life of the associated lease. Amortization expense of assets acquired under capital leases is included in depreciation expense. 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 the Company's consolidated statements of operations. The Company performs an assessment of the fair value of the assets if indicators of impairment are identified during a reporting period and records the assets at the lower of the net book value or the fair value of the assets.

The Company capitalizes internal 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. The Company records certain construction costs incurred by a landlord as an asset and a corresponding financing obligation on the Company's consolidated balance sheets when the Company is determined to be the owner of a building during construction for accounting purposes. Upon completion of the project, the Company performs a sale-leaseback analysis to determine if the Company can remove the assets and corresponding liability from its consolidated balance sheet.

Capital Leases

The assets and liabilities associated with capital lease agreements are recorded at the present value of the minimum lease payments at the inception of the lease agreement. The assets are depreciated using the straight-line method over the shorter of the useful life of the related asset or the remaining life of the associated lease. Amortization of assets that the Company leases pursuant to a capital lease is included in depreciation expense. The Company performs an assessment of the fair value of the assets if indicators of impairment are identified during a reporting period and records the assets at the lower of the net book value or the fair value of the assets. Assets recorded under capital leases are recorded in "Property and equipment, net" and liabilities related to those assets are recorded in "Capital lease obligations, current portion" and "Capital lease obligations, excluding current portion" on the Company's consolidated balance sheets.

Income Taxes

Deferred tax assets and liabilities are recognized for the expected future tax consequences of temporary differences between the financial statement carrying amounts and the income tax bases of assets and liabilities. 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, the Company reassesses the valuation allowance on its deferred income tax assets weighing positive and negative evidence to assess the recoverability of its deferred tax assets. The Company includes, among other things, its recent financial performance and its future projections in this periodic assessment.

The Company records 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. The Company does not believe any such uncertain tax positions currently pending will have a material adverse effect on its consolidated financial statements.

Variable Interest Entities

The Company reviews each collaboration agreement pursuant to which it licenses assets owned by a collaborator in order to determine whether or not it has a variable interest via the license agreement with the collaborator and if the variable interest is a variable interest in the collaborator as a whole. In assessing whether the Company has a variable interest in the collaborator as a whole, the Company considers and makes judgments regarding the purpose and design of the entity, the value of the licensed assets to the collaborator, the value of the collaborator's total assets and the significant activities of the collaborator. If the Company has a variable interest in the collaborator as a whole, the Company assesses whether or not the Company is the primary beneficiary of that VIE based on a number of factors, including (i) which party has the power to direct the activities that most significantly affect the VIE's economic

performance, (ii) the parties' contractual rights and responsibilities pursuant to the collaboration agreement and (iii) which party has the obligation to absorb losses of or the right to receive benefits from the VIE that could be significant to the VIE. If the Company determines it is the primary beneficiary of a VIE at the onset of the collaboration agreement, the collaboration is treated as a business combination and the Company consolidates the financial statements of the VIE into the Company's consolidated financial statements. On a quarterly basis,

the Company evaluates whether it continues to be the primary beneficiary of any consolidated VIEs. If the Company determines that it is no longer the primary beneficiary of a consolidated VIE, or no longer has a variable interest in the VIE, it deconsolidates the VIE in the period that the determination is made.

Assets and liabilities recorded as a result of consolidating VIEs' financial results into the Company's consolidated balance sheet do not represent additional assets that could be used to satisfy claims against the Company's general assets or liabilities for which creditors have recourse to the Company's general assets.

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

The present-value models the Company uses to estimate the fair values of in-process research and development assets and contingent payments pursuant to collaborations incorporate significant assumptions.

The Company's discounted cash flow models pertaining to in-process research and development assets include: (i) assumptions regarding the probability of obtaining marketing approval or a drug candidate; (ii) estimates regarding the timing of and the expected costs to develop and commercialize a drug candidate; (iii) estimates of future cash flows from potential product sales with respect to a drug candidate; and (iv) appropriate discount and tax rates.

The Company bases its 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 for similar assets and its own experience. 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. The discount rates used in the valuation model for contingent payments 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. As of December 31, 2018, the Company does not have any in-process research and development assets recorded on its consolidated balance sheet and the fair value of contingent payments pursuant to its collaborations is zero due to the deconsolidation of BioAxone.

In-process Research and Development Assets

The Company records 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 the Company's consolidated balance sheet until either the project underlying it 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.

In-process research and development assets that are acquired in a transaction that does not qualify as a business combination under GAAP and that do not have an alternative future use are expensed in the period in which the assets are acquired.

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.

Noncontrolling Interest

The Company records "Noncontrolling interest," which has historically related to consolidated VIEs, on its consolidated balance sheets. The Company records "Loss (income) attributable to noncontrolling interest" on its consolidated statements of operations, reflecting the VIEs' net loss (income) for the reporting period, adjusted for changes in the noncontrolling

interest holders' claim to net assets, including contingent milestone, royalty and option payments, each of which is evaluated each reporting period.

Deconsolidation and Discontinued Operations

Upon the occurrence of certain events and on a regular basis, the Company evaluates whether it no longer has a controlling interest in its subsidiaries, including consolidated VIEs. If the Company determines it no longer has a controlling interest, the subsidiary is deconsolidated. The Company records a gain or loss on deconsolidation based on the difference on the deconsolidation date between (i) the aggregate of (a) the fair value of any consideration received, (b) the fair value of any retained noncontrolling investment in the former subsidiary and (c) the carrying amount of any noncontrolling interest in the subsidiary being deconsolidated, less (ii) the carrying amount of the former subsidiary's assets and liabilities.

The Company assesses whether a deconsolidation is required to be presented as discontinued operations in its consolidated financial statements on the deconsolidation date. This assessment is based on whether or not the deconsolidation represents a strategic shift that has or will have a major effect on the Company's operations or financial results. If the Company determines that a deconsolidation requires presentation as a discontinued operation on the deconsolidation date, or at any point during the one year period following such date, it will present the former subsidiary as a discontinued operation in current and comparative period financial statements.

Derivative Instruments and Embedded Derivatives

The Company has entered into financial transactions involving free-standing derivative instruments and embedded derivatives in the past. Embedded derivatives are required to be bifurcated from the host instruments if the derivatives are not clearly and closely related to the host instruments. The Company determines the fair value of each derivative instrument or embedded derivative that is identified on the date of issuance and at the end of each quarterly period. The estimates of the fair value of the derivatives include significant assumptions regarding the estimates market participants would make in order to evaluate these derivatives.

Hedging Activities

The Company recognizes the fair value of hedging instruments that are designated and qualify as hedging instruments pursuant to GAAP, foreign currency forward contracts, as either assets or liabilities on the consolidated balance sheets. Changes in the fair value of these instruments are recorded each period in "Accumulated other comprehensive income (loss)" 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 liabilities, current portion" or "Other liabilities, excluding current portion," respectively, on the Company's 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 the consolidated statement of operations in the same period that it recognizes the product revenues that were impacted by the hedged foreign exchange rate changes. The Company classifies the cash flows from hedging instruments in the same category as the cash flows from the hedged items.

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

The Company assesses, both at inception and on an ongoing basis, whether the foreign currency forward contracts used in hedging transactions are highly effective in offsetting the changes in cash flows of the hedged items. The Company also assesses hedge ineffectiveness quarterly and, if determined to be ineffective, records the gain or loss related to the ineffective portion to earnings in "Other (expense) income, net" in its consolidated statements of operations. The Company did not record any ineffectiveness related to these hedging transactions in the three years ended December 31, 2018.

The Company also enters 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 GAAP. Realized gains and losses for such contracts are recognized in “Other (expense) income, net” in the consolidated statement of operations each period.

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Notes to Consolidated Financial Statements (Continued)

Restructuring Expenses

The Company records costs and liabilities associated with exit and disposal activities based on estimates of fair value in the period the liabilities are incurred. The Company's exit and disposal activities have primarily been associated with the Company's facilities, but also have included the termination of employees in some cases. The Company's initial estimate of its liabilities for net ongoing costs associated with its facility obligations are recorded at fair value on the cease use date. On a quarterly basis, the Company evaluates and adjusts these liabilities as appropriate for changes in circumstances. Changes to the Company's estimate of these liabilities are recorded as additional restructuring expenses (credits). These costs are included in "Restructuring (income) expenses" on the Company's consolidated statements of operations.

The Company has adopted several plans to restructure its facilities and operations for which it has incurred restructuring expenses. The most significant restructuring event during the three years ended December 31, 2018 commenced in February 2017 upon the Company's decision to consolidate its research activities into its Boston, Milton Park and San Diego locations. The Company closed its research site in Canada as a result of this decision affecting approximately 70 positions. The Company's lease for its research site in Canada expired in October 2018. As of December 31, 2018, the Company has no restructuring liabilities recorded on its consolidated balance sheet and does not anticipate any additional charges related to this restructuring event in the future.

Comprehensive Income (Loss)

Comprehensive income (loss) consists of net income (loss) and other comprehensive income (loss), which includes foreign currency translation adjustments and unrealized gains and losses on foreign currency forward contracts and certain marketable securities. For purposes of comprehensive income (loss) disclosures, the Company records provisions for or benefits from income taxes related to the unrealized gains and losses on foreign currency forward contracts and certain marketable securities. The Company does not record provisions for or benefits from income taxes related to the cumulative translation adjustment, as the Company intends to permanently reinvest undistributed earnings in its foreign subsidiaries.

Foreign Currency Translation and Transactions

The majority of the Company's operations occur in entities that have the U.S. dollar denominated as their functional currency. Non-U.S. dollar denominated functional currency subsidiaries have assets and liabilities translated into U.S. dollars at rates of exchange in effect at the end of the year. Revenue and expense amounts are translated using the average exchange rates for the period. Net unrealized gains and losses resulting from foreign currency translation are included in "Accumulated other comprehensive income (loss)." Net foreign currency exchange transaction gains or losses are included in "Other (expense) income, net" on the Company's consolidated statement of operations. Net transaction losses were $1.1 million and $5.5 million for 2018 and 2017, respectively, and net transaction gains were $4.0 million for 2016. These net foreign currency exchange gains or losses are presented net of the impact of the foreign currency forward contracts designed to mitigate their effect on the Company's consolidated statement of operations.

Net Loss Per Share Attributable to Vertex Common Shareholders

Basic and diluted net loss per share attributable to Vertex common shareholders are presented in conformity with the two-class method required for participating securities. Under the two-class method, earnings are allocated to (i) Vertex common shares, excluding unvested restricted stock, and (ii) participating securities, based on their respective weighted-average shares outstanding for the period. Shares of unvested restricted stock granted under the Company's Amended and Restated 2006 Stock and Option Plan have the non-forfeitable right to receive dividends on an equal basis with other outstanding common stock. As a result, these unvested shares of restricted stock are considered participating securities under the two-class method. Potentially dilutive shares result from the assumed exercise of outstanding stock options (the proceeds of which are then assumed to have been used to repurchase outstanding stock using the treasury stock method).

Basic net loss per share attributable to Vertex common shareholders is based upon the weighted-average number of common shares outstanding during the period, excluding restricted stock that has been issued but is not yet vested. Diluted net loss per share attributable to Vertex common shareholders 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.

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Notes to Consolidated Financial Statements (Continued)

Recently Adopted Accounting Pronouncements

Revenue Recognition

In 2014, the Financial Accounting Standards Board ("FASB") issued ASC 606. The new guidance became effective January 1, 2018. ASC 606 applies a more principles-based approach to recognizing revenue. Under ASC 606, revenue is recognized when a customer obtains control of promised goods or services in an amount that reflects the consideration that an entity expects to receive in exchange for those goods or services. In addition, the standard requires disclosure of the nature, amount, timing, and uncertainty of revenue and cash flows arising from contracts with customers. The Company adopted ASC 606 on January 1, 2018 using the modified-retrospective adoption method for all contracts that were not completed as of the date of adoption. Under the modified-retrospective method, the Company recognized the cumulative effect of applying the standard within "Accumulated deficit" on its consolidated balance sheet as of January 1, 2018.

For all reporting periods, the Company has not disclosed the value of unsatisfied performance obligations for all product revenue contracts with an original expected length of one year or less, which is an optional exemption that is permitted under the adoption rules.

Based on the Company's review of existing customer contracts as of January 1, 2018, it concluded that the only significant impact that the adoption of ASC 606 had on its financial statements relates to shipments of ORKAMBI under early access programs in France. Prior to the adoption of ASC 606, the Company did not recognize revenue on the proceeds received from sales of ORKAMBI under early access programs in France because the price was not fixed or determinable based on the status of ongoing pricing discussions. As of January 1, 2018, the Company recorded a cumulative effect adjustment to its accumulated deficit of $8.3 million related to the adoption of ASC 606, which primarily represented the Company's estimated amount of consideration it expects to retain related to these shipments that will not be subject to a significant reversal in amounts recognized, net of costs previously deferred related to these shipments. Please refer to "Product Revenues, Net" above for further information related to the impact of the new revenue recognition on these sales.

The Company concluded that the remaining $6.9 million that was recorded as deferred revenues as of December 31, 2017 related to the Company's 2008 sale of its HIV protease inhibitor royalty stream is not subject to ASC 606 because it was initially accounted for pursuant to ASC 470, Debt, which is not under the scope of ASC 606. The Company has continued to recognize the payment received as royalty revenues over the expected life of the collaboration agreement with GlaxoSmithKline plc based on the units-of-revenue method.

The cumulative effect of applying ASC 606 to the Company's contracts with customers that were not completed as of January 1, 2018 was as follows:

	Balance as of December 31, 2017	Adjustments	Balance as of January 1, 2018
Assets	(in thousands)		
Accounts receivable, net	$281,343	$ 29,881	$311,224
Inventories	111,830	(90)	111,740
Prepaid expenses and other current assets	167,124	(17,166)	149,958
Total assets	$3,546,014	$ 12,625	$3,558,639
Liabilities and Shareholders' Equity			
Accrued expenses	$443,961	$ 8,586	$452,547
Early access sales accrual	232,401	(7,273)	225,128
Other liabilities, current portion	34,373	2,083	36,456
Accumulated other comprehensive income (loss)	(11,572)	949	(10,623)
Accumulated deficit	(5,119,723)	8,280	(5,111,443)

Total liabilities and shareholders' equity	$3,546,014	$ 12,625	$3,558,639

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The impact of adoption on the Company's consolidated balance sheet as of December 31, 2018 was as follows:

	As of December 31, 2018		
	As Reported under ASC 606	Balances without Adoption of ASC 606	Effect of Change Higher/(Lower)
Assets	(in thousands)		
Accounts receivable, net	$409,688	$376,949	$ 32,739
Inventories	124,360	124,506	(146)
Prepaid expenses and other current assets	140,819	167,522	(26,703)
Total assets	$6,245,898	$6,240,008	$ 5,890
Liabilities and Shareholders' Equity			
Accrued expenses	$604,495	$618,873	$ (14,378)
Early access sales accrual	354,404	380,609	(26,205)
Other liabilities, current portion	40,589	14,355	26,234
Accumulated other comprehensive income (loss)	659	927	(268)
Accumulated deficit	(2,989,478)	(3,009,985)	20,507
Total liabilities and shareholders' equity	$6,245,898	$6,240,008	$ 5,890

The impact of adoption on the Company's consolidated statement of operations for the year ended December 31, 2018 was as follows:

	Year Ended December 31, 2018		
	As Reported under ASC 606	Balances without Adoption of ASC 606	Effect of Change Higher/(Lower)
	(in thousands)		
Product revenues, net	$3,038,325	$3,019,484	$ 18,841
Cost of sales	409,539	402,925	6,614
Income from operations	635,150	622,923	12,227
Net income attributable to Vertex	$2,096,896	$2,084,669	$ 12,227
Amounts per share attributable to Vertex common shareholders:			
Net income:			
Basic	$8.24	$8.20	$ 0.04
Diluted	$8.09	$8.04	$ 0.05

ASC 606 did not have an aggregate impact on the Company's net cash provided by operating activities, but resulted in offsetting changes in certain assets and liabilities presented within net cash provided by operating activities in the Company's consolidated statement of cash flows.

Equity Investments

In 2016, the FASB issued ASU 2016-01, which amended guidance related to the recording of financial assets and financial liabilities. Under ASU 2016-01, equity investments (except those accounted for under the equity method of accounting or those that result in consolidation of an investee) are measured at fair value with changes in fair value recognized in net income (loss). However, an entity has the option to measure equity investments without readily determinable fair values at (i) fair value or (ii) cost adjusted for changes in observable prices minus impairment. Changes in measurement under either alternative are recognized in net income (loss). ASU 2016-01 became effective

January 1, 2018 and required the modified-retrospective adoption method. As of January 1, 2018, the Company held publicly traded equity investments and equity investments accounted for under the cost method. As a result, in 2018, the Company recorded a $25.1 million cumulative effect adjustment to “Accumulated deficit” related to its publicly traded equity investments equal to the unrealized gain, net of tax, that was recorded in “Accumulated other comprehensive income (loss)” as of December 31, 2017. The adoption of ASU 2016-01 had no effect on the Company’s equity investments accounted for under the cost method

because the original cost basis of these investments was recorded on the Company's consolidated balance sheet as of December 31, 2017. The Company recorded net unrealized gains of $2.6 million to "Other (expense) income, net" in its consolidated statement of operations related to the change in fair value of its equity investments in the year ended December 31, 2018.

Intra-Entity Transfers

In 2016, the FASB issued ASU No. 2016-16, Intra-Entity Transfers of Assets Other Than Inventory ("ASU 2016-16"), which removes the previous exception in GAAP prohibiting an entity from recognizing current and deferred income tax expenses or benefits related to the transfer of assets, other than inventory, within the consolidated entity. The exception to defer the recognition of any tax impact on the transfer of inventory within the consolidated entity until it is sold to a third party remains unaffected. ASU 2016-16 became effective January 1, 2018. In 2018, upon adoption of ASU 2016-16, the Company recorded a deferred tax asset and corresponding full valuation allowance of $204.7 million equal to the unamortized cost of intellectual property rights transferred to the United Kingdom in 2014 multiplied by an appropriate statutory rate. There was no cumulative effect adjustment to "Accumulated deficit" using the modified-retrospective adoption method.

Goodwill

In 2017, the FASB issued ASU No. 2017-04, Intangibles - Goodwill and Other (Topic 350) ("ASU 2017-04") related to measurements of goodwill. ASU 2017-04 modifies the concept of impairment from the condition that exists when the carrying amount of goodwill exceeds its implied fair value to the condition that exists when the carrying amount of a reporting unit exceeds its fair value, which eliminates Step 2 from the goodwill impairment test. An entity would recognize an impairment charge for the amount by which the carrying amount exceeds the reporting unit's fair value; however, the loss recognized should not exceed the total amount of goodwill allocated to the related reporting unit. The Company early adopted ASU 2017-04 and utilized this approach for annual and interim goodwill impairment tests conducted after January 1, 2018. The adoption of ASU 2017-04 did not have a significant effect on the Company's consolidated financial statements.

Stock-Based Compensation - Modifications

In 2017, the FASB issued ASU No. 2017-09, Compensation - Stock Compensation (Topic 718) ("ASU 2017-09") related to the scope of stock option modification accounting, to reduce diversity in practice and provide clarity regarding existing guidance. ASU 2017-09 became effective January 1, 2018. The Company does not expect the adoption of ASU 2017-09 to have a significant effect on its consolidated financial statements in future periods and had no effect in the year ended December 31, 2018.

Cash Flows - Restricted Cash

In 2016, the FASB issued ASU No. 2016-18, Statement of Cash Flows (Topic 230) Restricted Cash ("ASU 2016-18"), which requires that a statement of cash flows explain the change during the period in the total of cash, cash equivalents and restricted cash. Therefore, amounts described as restricted cash should be included with cash and cash equivalents when reconciling the beginning of period and end of period amounts shown on the statement of cash flows. ASU 2016-18 became effective January 1, 2018 and is effective on a retrospective basis. The cash, cash equivalents and restricted cash balances for the years ended December 31, 2018 through 2015, which are presented in the Company's consolidated statements of cash flows subsequent to the adoption of ASU 2016-18, consisted of the following:

	As of December 31,			
	2018	2017	2016	2015
	(in thousands)			
Cash and cash equivalents	$2,650,134	$1,665,412	$1,183,945	$714,768
Prepaid expenses and other current assets	4,910	2,114	47,762	78,910
Other assets	3,209	—	—	22,083
Cash, cash equivalents and restricted cash per statement of cash flows	$2,658,253	$1,667,526	$1,231,707	$815,761

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The Company's restricted cash is included in "Prepaid expenses and other current assets" and "Other assets," if any, in its consolidated balance sheets. As of December 31, 2017, the Company recorded its VIE's cash and cash equivalents, which were not material to the Company's financial statements, as "Prepaid expenses and other current assets" because (i) the Company did not have any interest in or control over BioAxone's cash and cash equivalents and (ii) the Company's agreement with BioAxone did not provide for BioAxone's cash and cash equivalents to be used for the development of the asset that the Company licensed from BioAxone. As of December 31, 2018, the Company does not have any consolidated VIEs.

Stock-Based Compensation - Improvements

In 2016, the FASB issued ASU No. 2016-09, Compensation—Stock Compensation (Topic 718) Improvements to Employee Share-Based Payment Accounting ("ASU 2016-09"), which simplifies the accounting for employee share-based payment transactions, including the accounting for income taxes, forfeitures, and statutory tax withholding requirements, as well as classification in the statement of cash flows. ASU 2016-09 became effective January 1, 2017. ASU 2016-09 eliminated the requirement that excess tax benefits were realized as a reduction in current taxes payable before the associated tax benefit could be recognized as an increase in additional paid-in capital. This created a deferred tax asset ("DTA") of $410.8 million relating to federal and state net operating losses ("NOLs") that were fully reserved by an equal increase in the Company's valuation allowance as of January 1, 2017. The Company recorded DTAs of $404.7 million relating to federal NOLs and $6.1 million relating to state NOLs, both of which were offset by a full valuation allowance. Upon adoption, the Company also elected to change its accounting policy to account for forfeitures of options and awards as they occur. The change was applied on a modified-retrospective basis with a cumulative effect adjustment to increase "Accumulated deficit" by $9.4 million as of January 1, 2017. This change also resulted in an increase to the DTA of $3.4 million, which was offset by a full valuation allowance. As a result, there was no cumulative effect adjustment to accumulated deficit related to income taxes. The provisions related to the recognition of excess tax benefits in the Company's consolidated statement of operations and classification in the consolidated statement of cash flows were adopted prospectively, and as such, the prior periods were not retrospectively adjusted.

Recently Issued Accounting Standards

Leases

In 2016, the FASB issued ASU No. 2016-02, Leases (Topic 842) ("ASC 842"), which amends a number of aspects of lease accounting and requires entities to recognize right-of-use assets and liabilities on the balance sheet for leases with lease terms of more than 12 months. ASC 842 is effective on January 1, 2019. The Company's project team has substantially completed its review of its portfolio of existing leases and current accounting policies to identify and assess the potential differences that would result from applying the requirements of the new standard. The Company is also in the process of finalizing appropriate changes to its controls to support lease accounting and related disclosures under the new standard.

As discussed in Note L, "Long-term Obligations," the Company currently applies build-to-suit accounting and is the deemed owner of its leased corporate headquarters in Boston and research site in San Diego, for which it is recognizing depreciation expense over the buildings' useful lives and imputed interest on the corresponding construction financing lease obligations. Under ASC 842, the Company will account for these buildings as financing leases, resulting in increased depreciation expense over the respective lease terms, which are significantly shorter than the buildings' useful lives. The Company also expects a reduction in its imputed interest expense in the initial years of each financing lease term. In 2019, the Company expects an increase in operating expenses of approximately $26 million and a decrease in interest expense of approximately $13 million due to this change.

In July 2018, the FASB issued ASU No. 2018-11, Leases (Topic 842): Targeted Improvements ("ASU 2018-11"), which offers a transition option to entities adopting ASC 842. Under ASU 2018-11 entities can elect to apply ASC 842 using a modified-retrospective adoption approach resulting in a cumulative effect adjustment to accumulated deficit at the beginning of the year in which the new lease standard is adopted, rather than adjustments to the earliest

comparative period presented in their financial statements. The Company will adopt ASC 842 using the modified-retrospective method. In the first quarter of 2019, the Company expects to record a cumulative effect adjustment to increase its “Accumulated deficit” by approximately $50 million related to the adjustments to its build-to-suit leases described in the previous paragraph.

Additionally, the Company expects to record, upon adoption of ASC 842 on January 1, 2019, right-of-use assets of approximately $60 million and corresponding liabilities of approximately $70 million related to its real estate leases with terms of more than 12 months that are not treated as financing leases under ASC 842. The difference between these assets and liabilities will be primarily attributable to prepaid or accrued lease payments. The Company also anticipates reclassifying amounts recorded as “Capital lease obligations, current portion” and “Capital lease obligations, excluding current portion” as financing lease obligations on January 1, 2019. These adjustments will have no impact on the Company’s consolidated statement of operations and no impact on the Company’s accumulated deficit.

Derivatives and Hedging

In 2017, the FASB issued ASU No. 2017-12, Derivatives and Hedging (Topic 815) (“ASU 2017-12”), which helps simplify certain aspects of hedge accounting and enables entities to more accurately present their risk management activities in their financial statements. ASU 2017-12 is effective on January 1, 2019. The Company does not expect the adoption of ASU 2017-12 to have a significant effect on its consolidated financial statements.

Internal-Use Software

In 2018, the FASB issued ASU No. 2018-15, Intangibles—Goodwill and Other—Internal-Use Software (Subtopic 350-40): Customer’s Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement That Is a Service Contract (“ASU 2018-15”), which clarifies the accounting for implementation costs in cloud computing arrangements. ASU 2018-15 is effective on January 1, 2020. Early adoption is permitted. The Company currently is evaluating the impact the adoption of ASU 2018-15 may have on its consolidated financial statements.

Fair Value Measurement

In 2018, the FASB issued ASU No. 2018-13, Fair Value Measurement (Topic 820): Disclosure Framework-Changes to the Disclosure Requirements for Fair Value Measurement (“ASU 2018-13”), which modifies the disclosure requirements for fair value measurements. ASU 2018-13 is effective on January 1, 2020. Early adoption is permitted. The Company currently is evaluating the impact the adoption of ASU 2018-13 may have on its disclosures.

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B. Collaborative Arrangements and Acquisitions

The Company has entered into numerous agreements pursuant to which it collaborates with third parties on research, development and commercialization programs, including in-license and out-license agreements and asset acquisitions.

In-license Agreements

The Company has entered into a number of license agreements in order to advance and obtain access to technologies and services related to its research and early-development activities. The Company is generally required to make an upfront payment upon execution of the license agreement; 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 the collaboration.

Pursuant to the terms of its in-license agreements, the Company's collaborators lead the discovery efforts and the Company leads all preclinical, development and commercialization activities associated with the advancement of any drug candidates and funds all expenses unless otherwise described below.

The Company typically can terminate its in-license agreements by providing advance notice to it collaborators; the required length of notice is dependent on whether any product developed under the license agreement has received marketing approval. The Company's 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

In 2015, the Company 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. The Company has the exclusive right to license up to six CRISPR-Cas9-based targets, including targets for the potential treatment of sickle cell disease. In connection with the CRISPR Agreement, the Company made an upfront payment to CRISPR of $75.0 million and an investment in CRISPR's stock. The Company has also made several subsequent investments in CRISPR's common shares, which has resulted in CRISPR becoming a related party of the Company as of December 31, 2018. Please refer to Note E, "Marketable Securities and Equity Investments," for further information regarding the Company's investment in CRISPR's common stock.

The Company funds all the discovery activities conducted pursuant to the CRISPR Agreement. For targets that the Company elects to license, other than hemoglobinopathy treatments, the Company would lead all development and global commercialization activities. For each target that the Company elects to license, other than hemoglobinopathy targets, CRISPR has the potential to receive up to $420.0 million in development, regulatory and commercial milestones as well as royalties on net product sales. As part of the collaboration, the Company and CRISPR share equally all development costs and potential worldwide revenues related to potential hemoglobinopathy treatments, including treatments for beta-thalassemia and sickle cell disease.

In 2017, the Company entered into a co-development and co-commercialization agreement with CRISPR pursuant to the terms of the CRISPR Agreement, under which the Company and CRISPR are co-developing and will co-commercialize CTX001 (the "CTX001 Co-Co Agreement") for the treatment of hemoglobinopathy, including treatments for sickle cell disease and beta-thalassemia. The Company concluded that the CTX001 Co-Co Agreement is a cost-sharing arrangement, which results in the net impact of the arrangement being recorded in "Research and development expenses" in its consolidated statements of operations. During the year ended December 31, 2018, the net expense related to the CTX001 Co-Co Agreement was $19.7 million. Net expense related to the CTX001 Co-Co Agreement during the year ended December 31, 2017 was not significant.

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Other In-License Agreements

In 2016, the Company entered into a strategic collaboration and licensing agreement with Moderna Therapeutics, Inc. ("Moderna"), pursuant to which the parties are seeking to identify and develop messenger ribonucleic acid, or mRNA, therapeutics for the treatment of CF. The Company made an upfront payment to Moderna of $20.0 million, which was recorded to "Research and development expenses" and an investment in Moderna's preferred stock, which converted to common stock when Moderna became a publicly traded company in December 2018. Moderna has the potential to receive future development and regulatory milestones of up to $275.0 million as well as royalties on net product sales. Please refer to Note E, "Marketable Securities and Equity Investments," for further information regarding the Company's investment in Moderna's common stock.

In December 2018, the Company entered into a strategic collaboration and licensing agreement (the "Arbor Agreement") with Arbor Biotechnologies, Inc. ("Arbor") focused on the discovery of novel proteins, including DNA endonucleases, to advance the development of new gene-editing therapies. Pursuant to the Arbor Agreement, Arbor's platform technology is being applied in the collaboration activities for up to five Vertex disease areas in exchange for an upfront payment of $30.0 million. In addition, the Company received a convertible promissory note that matures in 2023 for an additional $15.0 million payment. For the each product identified by the collaboration, Arbor has the potential to receive up to $337.5 million in development, regulatory and commercial milestones as well as royalties on net product sales.

The Company determined that the fair value of the convertible promissory note approximated its contractual value upon agreement execution and is accounting for the convertible note at amortized cost. The Company determined that substantially all of the fair value of the Arbor Agreement was attributable to an in-process research and development asset and no substantive processes were acquired that would constitute a business. The Company concluded that it did not have any alternative future use for the acquired in-process research and development asset and recorded the $30.0 million upfront payment to "Research and development expenses."

Variable Interest Entities (VIEs)

The Company has license agreements with Parion and BioAxone, pursuant to which the Company licensed rights to certain drug candidates from these third-party collaborators that resulted in the consolidation of the third-parties' financial statements into the Company's consolidated financial statements as VIEs for portions or all of the three years ended December 31, 2018. The Company deconsolidated the financial statements of Parion as of September 30, 2017 and BioAxone as of December 31, 2018 from its consolidated financial statements. Please refer to Note J, "Intangible Assets and Goodwill," for further information regarding the impairment of Parion's pulmonary ENaC platform and BioAxone's VX-210 program that were related to these collaborations.

Parion Sciences, Inc.

In 2015, the Company entered into a strategic collaboration and license agreement (the "Parion Agreement") with Parion to collaborate with Parion to develop investigational epithelial sodium channel ("ENaC") inhibitors for the potential treatment of CF and all other pulmonary diseases. The Company is responsible for all costs, subject to certain exceptions, related to development and commercialization of the compounds.

Pursuant to the Parion Agreement, the Company has worldwide development and commercial rights to Parion's lead investigational ENaC inhibitors, VX-371 and VX-551, for the potential treatment of CF and all other pulmonary diseases. To date Parion has received $85.0 million in upfront and milestone payments under the Parion Agreement. Parion has the potential to receive additional development and regulatory milestones related to the ENaC inhibitors for the potential treatment of CF and all other pulmonary diseases.

Following execution of the Parion Agreement, the Company determined that it had a variable interest in Parion via the Parion Agreement, and that the variable interest represented a variable interest in Parion as a whole because the fair value of the ENaC inhibitors represented more than half of the total fair value of Parion's assets. The Company also concluded that it was the primary beneficiary as it had the power to direct the activities that most significantly affect the economic performance of Parion and that it had the obligation to absorb losses and right to receive benefits that

potentially could be significant to Parion. Accordingly, the Company consolidated Parion's financial statements beginning in June 2015.

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In the second quarter of 2017, Parion signed a license agreement with an affiliate of Shire plc related to the development of a drug candidate for the potential treatment of dry eye disease; however, the Company continued to consolidate Parion as a variable interest entity because it determined that there was no substantive change in the design of Parion subsequent to Parion's agreement with Shire. Based on the consolidation of Parion's financial statements, during the year ended December 31, 2017, the Company recognized $40.0 million of collaborative revenues and (ii) a tax provision of $14.8 million, both of which were attributable to noncontrolling interest related to payments that Parion received from Shire in the year ended December 31, 2017.

As of September 30, 2017, the Company determined that the fair value of Parion's pulmonary ENaC platform had declined significantly based on data received in September 2017 from a Phase 2 clinical trial of VX-371 that did not meet its primary efficacy endpoint. After evaluating the results of the clinical trial and based on the decrease in the fair value of Parion's pulmonary ENaC platform relative to Parion's other activities, the Company determined that it was no longer the primary beneficiary of Parion as it no longer had the power to direct the significant activities of Parion. Accordingly, the Company deconsolidated Parion as of September 30, 2017. The impairment charge of $255.3 million, the decrease in the fair value of the contingent payments payable by the Company to Parion of $69.6 million and the benefit from income taxes of $126.2 million resulting from these charges were recorded in the third quarter of 2017 and were attributable to noncontrolling interest. The benefit from income taxes consisted of benefits of $97.7 million attributable to the impairment charge and $28.5 million attributable to the decrease in the fair value of contingent payments. The net effect of these charges and impact of the deconsolidation was a loss of $7.1 million recorded in "Other (expense) income, net" attributable to Vertex in the consolidated statement of operations for the year ended December 31, 2017. The loss of $7.1 million was approximately the difference between (i) the aggregate of $85.0 million in upfront and milestone payments that the Company made to Parion pursuant to the Parion Agreement and (ii) losses the Company recorded in 2015, 2016 and the first half of 2017 based on increases in the fair value of contingent payments payable by the Company to Parion.

BioAxone Biosciences, Inc.

In 2014, the Company entered into a license and collaboration agreement (the "BioAxone Agreement") with BioAxone, which resulted in the consolidation of BioAxone as a VIE beginning in October 2014. The Company made an initial payment to BioAxone of $10.0 million in 2014. In the first quarter of 2018, an option held by the Company to purchase BioAxone expired and the Company paid a $10.0 million license continuation fee to BioAxone.

In October 2018, the Company announced it would stop clinical development of VX-210 and terminate the Phase 2b clinical trial of VX-210 based on the recommendation of the clinical trial's Data Safety Monitoring Board and the Company's review of interim data. In December 2018, the Company notified BioAxone of its intent to terminate the BioAxone Agreement and executed a release that immediately allowed BioAxone to control development of its neurological programs other than VX-210 without the Company's consent. As a result, the Company deconsolidated BioAxone as of December 31, 2018 because it determined that it no longer was the primary beneficiary of BioAxone as it no longer had the power to direct the significant activities of BioAxone. The net impact of the deconsolidation was not material to the Company's consolidated statement of operations.

The Company concluded that the deconsolidations of Parion and BioAxone, based on clinical data that did not meet expectations, were not developments that represented a significant strategic shift or had a material impact on the Company's overall operations and financial results or its plans to focus on developing and commercializing therapies for the treatment of CF and advancing its research and development programs in additional diseases. Therefore, the Company did not present the results related to Parion and BioAxone as discontinued operations in its consolidated statements of operations for the three years ended December 31, 2018.

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Aggregate VIE Financial Information
An aggregate summary of net loss attributable to noncontrolling interest related to the Company's VIEs for the three years ended December 31, 2018 was as follows:

	2018	2017	2016
	(in thousands)		
Loss attributable to noncontrolling interest before (benefit from) provision for income taxes and changes in fair value of contingent payments	$31,191	$223,379	$10,086
(Benefit from) provision for income taxes	(3,668)	(114,090)	16,743
(Increase) decrease in fair value of contingent payments	(17,730)	62,560	(54,850)
Net loss (income) attributable to noncontrolling interest	$9,793	$171,849	$(28,021)

The increase in the noncontrolling interest holders' claim to net assets with respect to the fair value of the contingent payments for the year ended December 31, 2018 was primarily due to the expiration of the Company's option to purchase BioAxone that increased the probability of the $10.0 million license continuation fee for VX-210 that was paid in 2018. The decrease in the noncontrolling interest holders' claim to net assets with respect to the fair value of the contingent payments for the year ended December 31, 2017 was primarily due to the decrease in the fair value of Parion's pulmonary ENaC platform described above. The increase in the fair value of the contingent payments for the year ended December 31, 2016 was primarily due to a separate Phase 2 clinical trial of VX-371 achieving its primary safety endpoint in 2016. The fair value of the contingent payments payable by the Company to BioAxone was zero, due to the deconsolidation of BioAxone, and $18.9 million as of December 31, 2018 and 2017, respectively. During three years ended December 31, 2018, the (increases) decreases in the fair value of the contingent payments related to the Company's VIEs were as follows:

	2018	2017	2016
	(in thousands)		
Parion	$—	$63,460	$(64,800)
BioAxone	(17,730)	(2,900)	9,950

As of December 31, 2018, the Company did not have any consolidated VIEs. As of December 31, 2017, the Company's consolidated balance sheet included the following significant amounts related to its consolidation of BioAxone as a VIE:

	December 31, 2017
	(in thousands)
Intangible assets	$ 29,000
Deferred tax liabilities	4,756
Noncontrolling interest	13,727

Asset Acquisition
Concert Pharmaceuticals
In 2017, the Company acquired certain CF assets including VX-561 (the "Concert Assets") from Concert Pharmaceuticals Inc. ("Concert") pursuant to an asset purchase agreement (the "Concert Agreement"). VX-561 is an investigational CFTR potentiator that has the potential to be used as part of combination regimens of CFTR modulators to treat CF. Pursuant to the Concert Agreement, Vertex paid Concert $160.0 million in cash for the Concert Assets. If VX-561 is approved as part of a combination regimen to treat CF, Concert could receive up to an additional $90.0 million in milestones based on regulatory approval in the United States and reimbursement in the United Kingdom, Germany or France. The Company determined that substantially all of the fair value of the Concert Agreement was attributable to a single in-process research and development asset, VX-561, which did not constitute a business. The Company concluded that it did not have any alternative future use for the acquired

in-process research and development asset. Thus, the Company recorded the $160.0 million upfront payment to "Research and development expenses" in 2017. The total cost of the transaction was $165.1 million including $5.1 million of transaction costs that were recorded to "Sales, general and administrative expenses."

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Out-license Agreements

The Company has entered into licensing agreements pursuant to which it has out-licensed rights to certain drug candidates to third-party collaborators. Pursuant to these out-license agreements, the Company's collaborators become responsible for all costs related to the continued development of such drug candidates and obtain development and commercialization rights to these drug candidates. Depending on the terms of the agreements, the Company's 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 the Company's in-license agreements.

Merck KGaA, Darmstadt, Germany

In January 2017, the Company entered into a strategic collaboration and license agreement (the "Oncology Agreement") with Merck KGaA, Darmstadt, Germany (the "Licensee"). Pursuant to the Oncology Agreement, the Company granted the Licensee an exclusive worldwide license to research, develop and commercialize four oncology research and development programs including two clinical-stage programs targeting DNA damage repair: its ataxia telangiectasia and Rad3-related protein kinase inhibitor program, or ATR program, including VX-970 and VX-803, and its DNA-dependent protein kinase inhibitor program, or DNA-PK program, including VX-984. In addition, the Company granted the Licensee exclusive, worldwide rights to two pre-clinical programs.

The Oncology Agreement provided for an upfront payment from the Licensee to the Company of $230.0 million. The Company evaluated the deliverables, primarily consisting of a license to the four programs and the obligation to complete certain fully-reimbursable research and development and transition activities as directed by the Licensee, pursuant to the Oncology Agreement, under the multiple element arrangement accounting guidance that was applicable in 2017. The Company concluded that the license had stand-alone value from the research and development and transition activities based on the resources and know-how possessed by the Licensee, and thus concluded that there are two units of accounting in the arrangement. The Company determined the relative selling price of the units of accounting based on the Company's best estimate of selling price. The Company utilized key assumptions to determine the best estimate of selling price for the license, which included future potential net sales of licensed products, development timelines, reimbursement rates for personnel costs, discount rates, and estimated third-party development costs. The Company utilized a discounted cash flow model to determine its best estimate of selling price for the license and determined the best estimate of selling price for the research and development and transition activities based on what it would sell the services for separately. Given the significance of the best estimate of selling price for the license as compared to the best estimate of selling price for the research and development and transition services, reasonable changes in the assumptions used in the discounted cash flow model would not have a significant impact on the relative selling price allocation. Based on this analysis, the Company recognized the $230.0 million upfront payment upon delivery of the license as well as research and development and transition activities during the year ended December 31, 2017. The Company records the reimbursement for the research and development and transition activities in its consolidated statements of operations as collaborative revenue primarily due to the fact that it is the primary obligor in the arrangement. The Company's activities related to the research and development and transition activities under the Oncology Agreement were substantially complete as of December 31, 2017.

In December 2018, the Company entered into an agreement with Merck KGaA, Darmstadt, Germany (the "DNA-PK Agreement") whereby the Company licensed the two lead Vertex DNA-PK compounds from its DNA-PK program for use in the field of gene integration for six specific indications. In exchange for this exclusive worldwide license to research, develop and commercialize the DNA-PK program for the specified indications within the field of gene integration, the Company made an upfront payment of $65.0 million. Merck KGaA, Darmstadt, Germany has the potential to receive additional milestones, primarily related to approval and reimbursement in various markets, as well as royalties on net product sales.

The Company evaluated the DNA-PK Agreement and concluded it represents a modification of the Oncology Agreement pursuant to ASC 606. As of December 2018, when the Company entered into the DNA-PK Agreement, the Company had completed its obligations under the Oncology Agreement, but the Oncology Agreement was an open contract pursuant to

ASC 606 since the Company could receive future royalty payments from the commercialization of the licensed programs under the Oncology Agreement.

In applying ASC 606, the Company determined that the license granted under the DNA-PK Agreement is distinct from the license granted by the Company under the Oncology Agreement since the license to the two lead Vertex DNA-PK compounds is capable of being distinct as the Company is able to benefit from the license via its ability to internally develop and commercialize the two lead Vertex DNA-PK compounds in the six named indications in the field of gene-editing, and the license is not dependent on Merck KGaA, Darmstadt, Germany providing any specialized services to the Company. In addition, the license to the two lead Vertex DNA-PK compounds granted to the Company under the DNA-PK Agreement is distinct from the license granted by the Company under the Oncology Agreement as the rights conveyed in the licenses differ and both parties have the ability to commercially benefit from the licenses on their own. Furthermore, the consideration attributable to the license of the two lead Vertex DNA-PK compounds represents fair value. Therefore, the Company determined it should account for the DNA-PK Agreement as a separate agreement.

The Company determined that substantially all of the fair value of the DNA-PK Agreement was attributable to a single in-process research and development asset that did not constitute a business. The Company concluded that it did not have any alternative future use for the acquired in-process research and development asset and recorded the $65.0 million payment to “Research and development expenses” accordingly.

Janssen Pharmaceuticals, Inc.

In 2014, the Company entered into an agreement with Janssen Pharmaceuticals, Inc. (“Janssen”). Pursuant to the agreement, Janssen has an exclusive worldwide license to develop and commercialize certain drug candidates for the treatment of influenza, including pimodivir. The Company received non-refundable payments of $35.0 million from Janssen in 2014 and recognized a $25.0 million milestone in 2017, based on a Phase 3 clinical trial Janssen initiated in 2017, that was collected in 2018.

Cystic Fibrosis Foundation

The Company has a research, development and commercialization agreement that was originally entered into in 2004 with Cystic Fibrosis Foundation (“CFF”), as successor in interest to the Cystic Fibrosis Foundation Therapeutics, Inc. This agreement was most recently amended in 2016 (the “2016 Amendment”). Pursuant to the agreement, as amended, the Company agreed to pay royalties ranging from low-single digits to mid-single digits on potential sales of certain compounds first synthesized and/or tested between March 1, 2014 and August 31, 2016, including VX-659 and VX-445, and tiered royalties ranging from single digits to sub-teens on any approved drugs first synthesized and/or tested during a research term on or before February 28, 2014, including KALYDECO (ivacaftor), ORKAMBI (lumacaftor in combination with ivacaftor) and SYMDEKO/SYMKEVI (tezacaftor in combination with ivacaftor). For combination products, such as ORKAMBI and SYMDEKO, sales are allocated equally to each of the active pharmaceutical ingredients in the combination product.

In 2016, CFF earned the last commercial milestone payment of $13.9 million payable by the Company pursuant to the agreement upon achievement of certain sales levels of lumacaftor. Pursuant to the 2016 Amendment, the Company received an upfront payment of $75.0 million and is receiving development funding from CFF of up to $6.0 million annually. The Company concluded that the upfront payment plus any future development funding represent a form of financing pursuant to ASC 730 and thus records the amounts as a liability on the consolidated balance sheet, primarily reflected in “Advance from collaborator, excluding current portion.” The Company reduces this liability over the estimated royalty term of the agreement and reflects the reductions as an offset to “Cost of sales” and as “Interest expense, net.”

The Company has royalty obligations to CFF for ivacaftor, lumacaftor and tezacaftor until the expiration of patents covering those compounds. The Company has patents in the United States and European Union covering the composition-of-matter of ivacaftor that expire in 2027 and 2025, respectively, subject to potential patent extension. The Company has patents in the United States and European Union covering the composition-of-matter of lumacaftor

that expire in 2030 and 2026, respectively, subject to potential extension. The Company has patents in the United States and European Union covering the composition-of-matter of tezacaftor that expire in 2027 and 2028, respectively, subject to potential extension.

C. Earnings Per Share

Basic net income (loss) per share attributable to Vertex common shareholders is based upon the weighted-average number of common shares outstanding during the period, excluding restricted stock, restricted stock units and performance-based restricted stock units, or PSUs, which have been issued but are not yet vested. Diluted net income (loss) per share attributable to Vertex common shareholders 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.

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Notes to Consolidated Financial Statements (Continued)

The following table sets forth the computation of basic and diluted net income (loss) per share for three years ended December 31, 2018:

	2018	2017	2016
	(in thousands, except per share amounts)		
Basic net income (loss) attributable to Vertex per common share calculation:			
Net income (loss) attributable to Vertex common shareholders	$2,096,896	$263,484	$(112,052)
Less: Undistributed earnings allocated to participating securities	(501)	(293)	—
Net income (loss) attributable to Vertex common shareholders—basic	$2,096,395	$263,191	$(112,052)
Basic weighted-average common shares outstanding	254,292	248,858	244,685
Basic net income (loss) attributable to Vertex per common share	$8.24	$1.06	$(0.46)
Diluted net income (loss) attributable to Vertex per common share calculation:			
Net income (loss) attributable to Vertex common shareholders	$2,096,896	$263,484	$(112,052)
Less: Undistributed earnings allocated to participating securities	(492)	(288)	—
Net income (loss) attributable to Vertex common shareholders—diluted	$2,096,404	$263,196	$(112,052)
Weighted-average shares used to compute basic net income (loss) per common share	254,292	248,858	244,685
Effect of potentially dilutive securities:			
Stock options	2,913	2,797	—
Restricted stock and restricted stock units (including PSUs)	1,963	1,542	—
Employee stock purchase plan	17	28	—
Weighted-average shares used to compute diluted net income (loss) per common share	259,185	253,225	244,685
Diluted net income (loss) attributable to Vertex per common share	$8.09	$1.04	$(0.46)

The Company did not include the securities in the following table in the computation of the net income (loss) per share attributable to Vertex common shareholders calculations because the effect would have been anti-dilutive during each period.

	2018	2017	2016
	(in thousands)		
Stock options	2,217	3,554	12,642
Unvested restricted stock and restricted stock units (including PSUs)	5	411	3,546

D. Fair Value Measurements

The fair value of the Company's financial assets and liabilities reflects the Company's estimate of amounts that it would have received in connection with the sale of the assets or paid in connection with the transfer of the liabilities in an orderly transaction between market participants at the measurement date. In connection with measuring the fair value of its assets and liabilities, the Company seeks to maximize the use of observable inputs (market data obtained from sources independent from the Company) and to minimize the use of unobservable inputs (the Company's assumptions about how market participants would price assets and liabilities). The following fair value hierarchy is used to classify assets and liabilities based on the observable inputs and unobservable inputs used in order to value the 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 the Company's assessment of the assumptions that market participants would use in pricing the asset or liability.

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The Company's investment strategy is focused on capital preservation. The Company invests in instruments that meet the credit quality standards outlined in the Company's investment policy. This policy also limits the amount of credit exposure to any one issue or type of instrument. As of December 31, 2018, the Company's investments were primarily in money market funds, U.S. Treasury securities, government-sponsored enterprise securities, corporate equity securities, corporate debt securities and commercial paper. Additionally, the Company utilizes foreign currency forward contracts intended to mitigate the effect of changes in foreign exchange rates on its consolidated statement of operations.

As of December 31, 2018, all of the Company's financial assets and liabilities that were subject to fair value measurements were valued using observable inputs. The Company's financial assets valued based on Level 1 inputs consisted of money market funds, U.S. Treasury securities, government-sponsored enterprise securities and corporate equity securities. The Company's financial assets and liabilities valued based on Level 2 inputs consisted of certain corporate equity securities as described below, corporate debt securities and commercial paper, which consisted of investments in highly-rated investment-grade corporations and foreign currency forward contracts with reputable and creditworthy counterparties. In 2018, Moderna became a publicly traded company. The Company has valued its investment in Moderna based on Level 2 inputs due to transfer restrictions for a period of time subsequent to Moderna's initial public offering. The reduction in fair value recorded on the Company's consolidated balance sheet related to this transfer restriction is not material to its financial statements. During 2018, 2017 and 2016, the Company did not record any other-than-temporary impairment charges related to its financial assets.

The following table sets forth the Company's financial assets and liabilities (excluding VIE cash and cash equivalents) subject to fair value measurements:

	Fair Value Measurements as of December 31, 2018			
		Fair Value Hierarchy		
	Total	Level 1	Level 2	Level 3
	(in thousands)			
Financial instruments carried at fair value (asset position):				
Cash equivalents:				
Money market funds	$1,226,603	$1,226,603	$—	$ —
U.S. Treasury securities	5,966	5,966	—	—
Government-sponsored enterprise securities	7,123	7,123	—	—
Commercial paper	58,268	—	58,268	—
Marketable securities:				
Corporate equity securities	167,323	153,733	13,590	—
U.S. Treasury securities	6,026	6,026	—	—
Government-sponsored enterprise securities	10,704	10,704	—	—
Corporate debt securities	233,665	—	233,665	—
Commercial paper	100,390	—	100,390	—
Prepaid and other current assets:				
Foreign currency forward contracts	19,023	—	19,023	—
Other assets:				
Foreign currency forward contracts	1,514	—	1,514	—
Total financial assets	$1,836,605	$1,410,155	$426,450	$ —
Financial instruments carried at fair value (liability position):				
Other liabilities, current portion:				
Foreign currency forward contracts	$(340)	$—	$(340)	$ —
Other liabilities, excluding current portion:				

Foreign currency forward contracts	(108)	—	(108)	—
Total financial liabilities	$(448)	$—	$(448)	$ —

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Notes to Consolidated Financial Statements (Continued)

	Fair Value Measurements as of December 31, 2017			
		Fair Value Hierarchy		
	Total	Level 1	Level 2	Level 3
	(in thousands)			
Financial instruments carried at fair value (asset position):				
Cash equivalents:				
Money market funds	$614,951	$614,951	$—	$ —
Government-sponsored enterprise securities	12,678	12,678	—	—
Commercial paper	57,357	—	57,357	—
Marketable securities:				
Corporate equity securities	74,821	74,821	—	—
Government-sponsored enterprise securities	2,303	2,303	—	—
Corporate debt securities	265,867	—	265,867	—
Commercial paper	80,263	—	80,263	—
Prepaid and other current assets:				
Foreign currency forward contracts	13	—	13	—
Total financial assets	$1,108,253	$704,753	$403,500	$ —
Financial instruments carried at fair value (liability position):				
Other liabilities, current portion:				
Foreign currency forward contracts	$(13,642)	$—	$(13,642)	$ —
Other liabilities, excluding current portion:				
Foreign currency forward contracts	(866)	—	(866)	—
Total financial liabilities	$(14,508)	$—	$(14,508)	$ —

Please refer to Note E, “Marketable Securities and Equity Investments,” for the carrying amount and related unrealized gains (losses) by type of the Company’s financial assets and liabilities.

As of December 31, 2018, the Company did not have any noncontrolling interest. As of December 31, 2017, the Company’s noncontrolling interest related to the Company’s VIE included the fair value of the contingent payments, which could consist of milestone, royalty and option payments, which were valued based on Level 3 inputs. Please refer to Note B, “Collaborative Arrangements and Acquisitions,” for further information regarding the fair value of the contingent payments.

E. Marketable Securities and Equity Investments

Pursuant to the adoption of ASU 2016-01 on January 1, 2018, the Company began recording changes in the fair value of its investments in corporate equity securities (except those accounted for under the equity method of accounting or those that result in consolidation of an investee) to “Other (expense) income, net” in the Company’s consolidated statements of operations. Prior to its adoption of ASU 2016-01, the Company recorded changes in the fair value of its investments in corporate equity securities to “Accumulated other comprehensive income (loss)” on its consolidated balance sheet until the related gains or losses were realized. The Company continues to record unrealized gains (losses) on available-for-sale debt securities as a component of accumulated other comprehensive income (loss) until such gains and losses are realized.

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Notes to Consolidated Financial Statements (Continued)

A summary of the Company's cash equivalents and marketable securities is shown below:

	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Fair Value
	(in thousands)			
As of December 31, 2018				
Cash equivalents:				
Money market funds	$1,226,603	$ —	$ —	$1,226,603
U.S. Treasury securities	5,967	—	(1)	5,966
Government-sponsored enterprise securities	7,124	—	(1)	7,123
Commercial paper	58,271	—	(3)	58,268
Total cash equivalents	1,297,965	—	(5)	1,297,960
Marketable securities:				
U.S Treasury securities (matures within 1 year)	6,026	—	—	6,026
Government-sponsored enterprise securities (matures within 1 year)	10,704	—	—	10,704
Corporate debt securities (matures within 1 year)	232,845	25	(450)	232,420
Corporate debt securities (matures after 1 year through 5 years)	1,243	2	—	1,245
Commercial paper (matures within 1 year)	100,498	—	(108)	100,390
Total marketable debt securities	351,316	27	(558)	350,785
Corporate equity securities	133,157	40,619	(6,453)	167,323
Total marketable securities	$484,473	$ 40,646	$ (7,011)	$518,108
As of December 31, 2017				
Cash equivalents:				
Money market funds	$614,951	$ —	$ —	$614,951
Government-sponsored enterprise securities	12,679	—	(1)	12,678
Commercial paper	57,371	—	(14)	57,357
Total cash equivalents	685,001	—	(15)	684,986
Marketable securities:				
Government-sponsored enterprise securities (matures within 1 year)	2,304	—	(1)	2,303
Corporate debt securities (matures within 1 year)	215,639	—	(363)	215,276
Corporate debt securities (matures after 1 year through 5 years)	50,697	—	(106)	50,591
Commercial paper (matures within 1 year)	80,372	—	(109)	80,263
Total marketable debt securities	349,012	—	(579)	348,433
Available-for-sale corporate equity securities	43,213	31,608	—	74,821
Total marketable securities	$392,225	$ 31,608	$ (579)	$423,254

Available-for-sale debt securities were recorded in the Company's consolidated balance sheets as follows:

	As of December 31,	
	2018	2017
	(in thousands)	
Cash and cash equivalents	$1,297,960	$684,986
Marketable securities	350,785	348,433
Total	$1,648,745	$1,033,419

The Company has a limited number of available-for-sale debt securities in insignificant loss positions as of December 31, 2018, which it does not intend to sell and has concluded it will not be required to sell before recovery of the amortized costs for the investments at maturity. The Company did not record any charges for other-than-temporary

declines in the fair value of available-for-sale debt securities or gross realized gains or losses in 2018, 2017 or 2016.

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Notes to Consolidated Financial Statements (Continued)

The Company maintains strategic investments separately from the investment policy that governs its other cash, cash equivalents and marketable securities. The Company's investments in the common stock of publicly traded companies have readily determinable fair values and are recorded in "Marketable securities" on its consolidated balance sheets. As of December 31, 2018, the fair value of the Company's investments in the common stock of CRISPR, a publicly traded company and a related party, and Moderna, which became a publicly traded company in December 2018, were $153.7 million and $13.6 million, respectively. During the year ended December 31, 2018, the Company recorded unrealized gains of $2.6 million related to its investment in corporate equity securities, which included an unrealized gain of $9.0 million related to its investment in CRISPR offset by an unrealized loss of $6.5 million related to its investment in Moderna. In 2018, the Company invested $69.9 million in additional shares of CRISPR's common stock.

As of December 31, 2018, the carrying value of the Company's equity investments without readily determinable fair values, which are recorded in "Other assets" on its consolidated balance sheets, was $13.6 million.

F. Accumulated Other Comprehensive Income (Loss)

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

		Unrealized Holding Gains (Losses), Net of Tax			
	Foreign Currency Translation Adjustment	On Available-For-Sale Debt Securities	On Equity Securities	On Foreign Currency Forward Contracts	Total
	(in thousands)				
Balance at December 31, 2015	$(2,080)	$126	$—	$3,778	$1,824
Other comprehensive (loss) income before reclassifications	(5,782)	(136)	17,531	17,383	28,996
Amounts reclassified from accumulated other comprehensive income (loss)	—	—	—	(9,647)	(9,647)
Net current period other comprehensive (loss) income	(5,782)	(136)	17,531	7,736	19,349
Balance at December 31, 2016	$(7,862)	$(10)	$17,531	$11,514	$21,173
Other comprehensive (loss) income before reclassifications	(13,169)	(584)	7,538	(29,175)	(35,390)
Amounts reclassified from accumulated other comprehensive income (loss)	—	—	—	2,645	2,645
Net current period other comprehensive (loss) income	(13,169)	(584)	7,538	(26,530)	(32,745)
Balance as of December 31, 2017	$(21,031)	$(594)	$25,069	$(15,016)	$(11,572)
Other comprehensive income before reclassifications	8,855	58	—	25,664	34,577
Amounts reclassified from accumulated other comprehensive income (loss)	—	—	—	1,774	1,774
Net current period other comprehensive income	8,855	58	—	27,438	36,351
Amounts reclassified to accumulated deficit pursuant to adoption of new accounting standard	949	—	(25,069)	—	(24,120)
Balance as of December 31, 2018	$(11,227)	$(536)	$—	$12,422	$659

G. Hedging

Foreign currency forward contracts - Designated as hedging instruments

The Company maintains a hedging program intended to mitigate the effect of changes in foreign exchange rates for a portion of the Company's forecasted product revenues denominated in certain foreign currencies. The program includes foreign currency forward contracts that are designated as cash flow hedges under GAAP having contractual durations from one to eighteen months. The Company recognizes realized gains and losses for the effective portion of such contracts in

VERTEX PHARMACEUTICALS INCORPORATED
Notes to Consolidated Financial Statements (Continued)

"Product revenues, net" in its consolidated statements of operations in the same period that it recognizes the product revenues that were impacted by the hedged foreign exchange rate changes.

The Company formally documents the relationship between foreign currency forward contracts (hedging instruments) and forecasted product revenues (hedged items), as well as the Company's 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. The Company also formally assesses, 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 the Company 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, the Company would discontinue hedge accounting treatment prospectively. The Company measures 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, 2018, all hedges were determined to be highly effective and the Company has not recorded any ineffectiveness related to its hedging program since inception.

The Company considers the impact of its counterparties' credit risk on the fair value of the foreign currency forward contracts. As of December 31, 2018 and December 31, 2017, credit risk did not change the fair value of the Company's foreign currency forward contracts.

The following table summarizes the notional amount of the Company's outstanding foreign currency forward contracts designated as cash flow hedges under GAAP:

	As of December 31,	
	2018	2017
Foreign Currency	(in thousands)	
Euro	$335,179	$257,230
British pound sterling	73,460	77,481
Australian dollar	52,820	30,501
Canadian dollar	43,759	—
Total foreign currency forward contracts	$505,218	$365,212

Foreign currency forward contracts - Not designated as hedging instruments

The Company also enters 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 under GAAP. The Company recognizes realized gains and losses for such contracts in "Other (expense) income, net" in its consolidated statements of operations each period. As of December 31, 2018, the notional amount of the Company's outstanding foreign currency forward contracts where hedge accounting under GAAP is not applied was $251.4 million.

During the three years ended December 31, 2018, the Company recognized the following related to foreign currency forward contacts in its consolidated statements of operations:

	December 31,		
	2018	2017	2016
	(in thousands)		
Designated as hedging instruments - Reclassified from AOCI			
Product revenues, net	$(1,252)	$768	$10,543
Not designated as hedging instruments			
Other (expense) income, net	$623	$14,129	$(6,917)

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Notes to Consolidated Financial Statements (Continued)

The following table summarizes the fair value of the Company's outstanding foreign currency forward contracts designated as cash flow hedges under GAAP included on its consolidated balance sheets:

As of December 31, 2018			
Assets		Liabilities	
Classification	Fair Value	Classification	Fair Value
	(in thousands)		
Prepaid and other current assets	$19,023	Other liabilities, current portion	$(340)
Other assets	1,514	Other liabilities, excluding current portion	(108)
Total assets	$20,537	Total liabilities	$(448)

As of December 31, 2017			
Assets		Liabilities	
Classification	Fair Value	Classification	Fair Value
	(in thousands)		
Prepaid and other current assets	$ 13	Other liabilities, current portion	$(13,642)
Other assets	—	Other liabilities, excluding current portion	(866)
Total assets	$ 13	Total liabilities	$(14,508)

As of December 31, 2018, the Company expects amounts that are related to foreign exchange forward contracts designated as cash flow hedges under GAAP recorded in "Prepaid expenses and other current assets" and "Other liabilities, current portion" to be reclassified to earnings within twelve months.

The following table summarizes the potential effect of offsetting derivatives by type of financial instrument designated as cash flow hedges under GAAP on the Company's consolidated balance sheets:

	As of December 31, 2018				
	Gross Amounts Recognized	Gross Amounts Offset	Gross Amounts Presented	Gross Amounts Not Offset	Legal Offset
Foreign currency forward contracts	(in thousands)				
Total assets	$20,537	$ —	$20,537	$ (448)	$20,089
Total liabilities	(448)	—	(448)	448	—

	As of December 31, 2017				
	Gross Amounts Recognized	Gross Amounts Offset	Gross Amounts Presented	Gross Amounts Not Offset	Legal Offset
Foreign currency forward contracts	(in thousands)				
Total assets	$13	$ —	$ 13	$ (13)	$ —
Total liabilities	(14,508)	—	(14,508)	13	(14,495)

H. Inventories

Inventories consisted of the following:

	As of December 31,	
	2018	2017
	(in thousands)	
Raw materials	$9,677	$20,924

Work-in-process	87,944	74,237
Finished goods	26,739	16,669
Total	$124,360	$111,830

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I. Property and Equipment

Property and equipment, net consisted of the following:

	As of December 31,	
	2018	2017
	(in thousands)	
Buildings	$657,438	$634,061
Furniture and equipment	280,908	256,509
Software	162,601	151,890
Leasehold improvements	103,428	117,806
Computers	59,073	61,294
Total property and equipment, gross	1,263,448	1,221,560
Less: accumulated depreciation	(451,443)	(432,123)
Total property and equipment, net	$812,005	$789,437

Total property and equipment, gross, as of December 31, 2018 and 2017, included $94.8 million and $100.9 million, respectively, for property and equipment recorded under capital leases. Accumulated depreciation, as of December 31, 2018 and 2017, included $34.0 million and $43.4 million, respectively, for property and equipment recorded under capital leases.

The Company recorded depreciation expense of $72.4 million, $61.4 million and $60.8 million in 2018, 2017 and 2016, respectively. The Company's capital lease amortization is included in depreciation expense.

J. Intangible Assets and Goodwill

Intangible Assets

As of December 31, 2018, the Company had no in-process research and development intangible assets recorded on its consolidated balance sheet. As of December 31, 2017, the Company had a $29.0 million in-process research and development intangible asset related to VX-210 that was licensed from BioAxone in 2014 recorded on its consolidated balance sheet.

In October 2018, the Company announced it would stop clinical development of VX-210 and terminate the Phase 2b clinical trial of VX-210 based on the recommendation of the clinical trial's Data Safety Monitoring Board and the Company's review of interim data the Company received in October 2018. As a result of this decision, the Company recorded a $29.0 million impairment charge and a benefit from income taxes of $7.9 million in 2018 attributable to noncontrolling interest.

In 2017, the Company determined that there were indicators that the value of the Parion's pulmonary ENaC platform intangible asset had become impaired. Prior to this determination, the Company reflected a $255.3 million in-process research and development intangible asset on its consolidated balance sheet related to Parion's pulmonary ENaC platform, which included the intellectual property related to VX-371 and VX-551 that are licensed by Parion to the Company. The Company determined that the fair value of the intangible asset had decreased significantly based on data from a Phase 2 clinical trial of VX-371 that did not meet its primary efficacy endpoint. Based on this data, the Company evaluated the fair value of Parion's pulmonary ENaC platform using the discounted cash flow approach from the perspective of a market participant and determined that the fair value of the intangible asset was zero as of September 30, 2017. The Company recorded a $255.3 million impairment charge and a benefit from income taxes of $97.7 million in 2017 attributable to noncontrolling interest.

Goodwill

As of each of December 31, 2018 and December 31, 2017, goodwill of $50.4 million was recorded on the Company's consolidated balance sheet.

K. Additional Balance Sheet Detail

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Notes to Consolidated Financial Statements (Continued)

Prepaid and other current assets consisted of the following:

	As of December 31,	
	2018	2017
	(in thousands)	
Prepaid expenses	$74,045	$62,475
Collaborative accounts receivable	5,182	28,907
Other receivables and assets	61,592	75,742
Total	$140,819	$167,124

Accrued expenses consisted of the following:

	As of December 31,	
	2018	2017
	(in thousands)	
Payroll and benefits	$124,753	$113,026
Research, development and commercial contract costs	115,300	98,411
Product revenue allowances	195,598	119,919
Royalty payable	101,108	73,044
Other	67,736	39,561
Total	$604,495	$443,961

L. Long-term Obligations

Construction Financing Lease Obligation

As a result of the Company being involved in the construction of several of its leased buildings in Boston and San Diego, the Company was deemed for accounting purposes to be the owner of these buildings during their construction periods and recorded project construction costs incurred by its landlords. Upon completion of these buildings, the Company determined that the underlying leases did not meet the criteria for “sale-leaseback” treatment. Accordingly, the Company depreciates the lease assets and records interest expense associated with the financing obligations for these buildings. The Company bifurcates the lease payments pursuant to these leases into (i) a portion that is allocated to the buildings and (ii) a portion that is allocated to the land on which the buildings were constructed. The portion of the lease obligations allocated to the land is treated as an operating lease.

Fan Pier Leases

In 2011, the Company entered into two lease agreements, pursuant to which the Company leases approximately 1.1 million square feet of office and laboratory space in two buildings (the “Fan Pier Buildings”) at Fan Pier in Boston, Massachusetts (the “Fan Pier Leases”). The Company commenced lease payments in December 2013, and will make lease payments pursuant to the Fan Pier Leases through December 2028. The Company has an option to extend the term of the Fan Pier Leases for an additional ten years.

San Diego Lease

In 2015, the Company entered into a lease agreement for a facility in San Diego, California (the “San Diego Building”), pursuant to which it leases approximately 170,000 square feet of office and laboratory space in San Diego, California (“San Diego Lease”) for a term of 16 years. Base rent payments will commence in the second quarter of 2019. Pursuant to the San Diego Lease, during the initial 16-year term, the Company will pay an average of approximately $10.2 million per year in aggregate rent, excluding operating expenses. The Company has the option to extend the lease term for up to two additional five-year terms.

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Notes to Consolidated Financial Statements (Continued)

Property and equipment, net and the carrying value of the Company's construction financing lease obligation (including current and non-current portions and excluding interest that will be imputed over the course of the Company's underlying lease agreements for these buildings) related to the Fan Pier Buildings and the San Diego Building were as follows:

	As of December 31,	
	2018	2017
	(in thousands)	
Property and equipment, net		
Fan Pier Buildings	$462,863	$475,725
San Diego Building	$113,296	$94,602
Construction financing lease obligation		
Fan Pier Buildings	$471,058	$472,070
San Diego Building	$96,105	$87,392

Revolving Credit Facility

In October 2016, the Company entered into a Credit Agreement (the "Credit Agreement") with Bank of America, N.A., as administrative agent and the lenders referred to therein. The Credit Agreement provides for a $500.0 million revolving facility, $300.0 million of which was drawn at closing (the "Loans") and was repaid in February 2017. The Credit Agreement also provides that, subject to satisfaction of certain conditions, the Company may request that the borrowing capacity under the Credit Agreement be increased by an additional $300.0 million. The Credit Agreement matures on October 13, 2021.

The proceeds of the borrowing under the Credit Agreement were used primarily to terminate and repay all outstanding obligations under the Company's senior secured term loan with Macquarie US Trading LLC, as administrative agent, that had been outstanding since 2014. The Loans will bear interest, at the Company's option, at either a base rate or a Eurodollar rate, in each case plus an applicable margin. Under the Credit Agreement, the applicable margins on base rate loans range from 0.75% to 1.50% and the applicable margins on Eurodollar loans range from 1.75% to 2.50%, in each case based on the Company's consolidated leverage ratio (the ratio of the Company's total consolidated debt to the Company's trailing twelve-month EBITDA).

The Loans are guaranteed by certain of the Company's domestic subsidiaries and secured by substantially all of the Company's assets and the assets of the Company's domestic subsidiaries (excluding intellectual property, owned and leased real property and certain other excluded property) and by the equity interests of the Company's subsidiaries, subject to certain exceptions. Under the terms of the Credit Agreement, the Company must maintain, subject to certain limited exceptions, a consolidated leverage ratio of 3.00 to 1.00 and consolidated EBITDA of at least $200.0 million, in each case measured on a quarterly basis.

The Credit Agreement contains customary representations and warranties and usual and customary affirmative and negative covenants. 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.

M. Common Stock, Preferred Stock and Equity Plans

Common Stock and Preferred Stock

The Company is authorized to issue 500,000,000 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 the Company's Board of Directors, and to share ratably in the Company's assets legally available for distribution to the Company's 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.

The Company is authorized to issue 1,000,000 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

VERTEX PHARMACEUTICALS INCORPORATED
Notes to Consolidated Financial Statements (Continued)

rights, voting rights, redemption terms, liquidation preferences and the number of shares constituting any series, without any further vote or action by the Company's shareholders. As of December 31, 2018 and 2017, the Company had no shares of preferred stock issued or outstanding.

Share Repurchase Program

The Company's Board of Directors approved a share repurchase program, pursuant to which the Company is authorized to repurchase up to $500.0 million of its common stock between February 1, 2018 and December 31, 2019. Under the share repurchase program, the Company is authorized to purchase shares from time to time through open market or privately negotiated transactions. Such purchases may be made pursuant to Rule 10b5-1 plans or other means as determined by the Company's management and in accordance with the requirements of the SEC.

During the year ended December 31, 2018, the Company repurchased 2,093,891 shares of its common stock under the share repurchase program for an aggregate of $350.0 million, including commissions and fees. The Company expects to fund further repurchases of its common stock through a combination of cash on hand and cash generated by operations.

Stock and Option Plans

The purpose of each of the Company's stock and option plans is to attract, retain and motivate its employees, consultants and directors. Awards granted under these plans can be incentive stock options ("ISOs"), nonstatutory stock options ("NSOs"), restricted stock ("RSs"), restricted stock units ("RSUs") including performance-based RSUs ("PSUs") or other equity-based awards, as specified in the individual plans.

Shares issued under all of the Company's plans are funded through the issuance of new shares. The following table contains information about the Company's equity plans:

			As of December 31, 2018	
Title of Plan	Group Eligible	Type of Award Granted	Awards Outstanding	Additional Awards Authorized for Grant
2013 Stock and Option Plan	Employees, Non-employee Directors and Consultants	NSO, RS, RSU and PSU	10,735,107	14,737,360
2006 Stock and Option Plan	Employees, Non-employee Directors and Consultants	NSO, RS and RSU	1,770,994	—
		Total	12,506,101	14,737,360

All options granted under the Company's 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, 2018, the stock and option plan under which the Company is authorized to make new equity awards is the Company's 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 the three years ended December 31, 2018, the Company's shareholders approved increases in the number of shares authorized for issuance pursuant to the 2013 Stock and Option Plan of (i) 8,000,000 shares in 2018, and (ii) 6,750,000 shares in 2017.

During the three years ended December 31, 2018, grants to current employees and directors primarily had a grant date that was the same as the date the award was approved by the Company's Board of Directors. During the three years ended December 31, 2018, for grants to new employees and directors, the date of grant for awards was the employee's first day of employment or the date the director was elected to the Company's Board of Directors. All options awarded under the Company's stock and option plans expire not more than 10 years from the grant date.

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Notes to Consolidated Financial Statements (Continued)

Stock Options

The following table summarizes information related to the outstanding and exercisable options during the year ended December 31, 2018:

	Stock Options	Weighted-average Exercise Price	Weighted-average Remaining Contractual Life	Aggregate Intrinsic Value
	(in thousands)	(per share)	(in years)	(in thousands)
Outstanding at December 31, 2017	9,767	$ 91.57		
Granted	2,297	$ 164.11		
Exercised	(3,076)	$ 85.66		
Forfeited	(431)	$ 125.37		
Expired	(6)	$ 98.30		
Outstanding at December 31, 2018	8,551	$ 111.46	6.92	$ 462,563
Exercisable at December 31, 2018	4,577	$ 93.21	5.63	$ 325,382

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 2018, which was $164.11 based on the average of the high and low price of the Company's 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 2018, 2017 and 2016 was $258.2 million, $302.8 million and $48.6 million, respectively. The total cash received by the Company as a result of employee stock option exercises during 2018, 2017 and 2016 was $263.4 million, $323.3 million and $48.5 million, respectively.

The following table summarizes information about stock options outstanding and exercisable at December 31, 2018:

	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)
$29.07–$40.00	532	1.08	$ 34.89	532	$ 35.89
$40.01–$60.00	470	3.51	$ 50.04	470	$ 50.04
$60.01–$80.00	543	5.25	$ 74.90	533	$ 74.89
$80.01–$100.00	2,839	7.18	$ 89.19	1320	$ 89.85
$100.01–$120.00	693	6.09	$ 109.30	603	$ 109.22
$120.01–$140.00	839	6.62	$ 130.27	642	$ 130.24
$140.01–$160.00	1,400	9.06	$ 155.52	271	$ 155.30
$160.01–$180.00	526	8.50	$ 162.94	156	$ 162.94
$180.01–$181.60	709	9.53	$ 181.60	50	$ 181.60
Total	8,551	6.92	$ 111.46	4,577	$ 93.21

VERTEX PHARMACEUTICALS INCORPORATED
Notes to Consolidated Financial Statements (Continued)

Restricted Stock and Restricted Stock Units (excluding PSUs)

The following table summarizes the restricted stock and restricted stock unit activity of the Company during the year ended December 31, 2018:

	Restricted Stock		Restricted Stock Units (excluding PSUs)	
	Number of Units (in thousands)	Weighted-average Grant-date Fair Value (per share)	Number of Shares (in thousands)	Weighted-average Grant-date Fair Value (per share)
Unvested at December 31, 2017	1,229	$ 102.12	2,011	$ 109.27
Granted	—	$ —	1,600	$ 164.70
Vested	(690)	$ 100.07	(629)	$ 108.02
Cancelled	(59)	$ 101.55	(265)	$ 132.26
Unvested at December 31, 2018	480	$ 104.91	2,717	$ 140.10

The total fair value of restricted stock that vested during 2018, 2017 and 2016 (measured on the date of vesting) was $114.5 million, $157.0 million and $74.1 million, respectively. The total fair value of restricted stock units that vested during 2018, 2017 and 2016 (measured on the date of vesting) was $104.8 million, $33.2 million and $5.3 million, respectively.

Performance-based RSUs (PSUs)

The potential range of shares issuable pursuant to the Company's 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 the Company's 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 the PSU activity of the Company during the year ended December 31, 2018:

	Performance-Based RSU	
	Number of Units (in thousands)	Weighted-average Grant-date Fair Value (per share)
Unvested at December 31, 2017 (1)	484	$ 87.59
Granted (2)	494	$ 152.40
Vested	(154)	$ 87.13
Cancelled	(65)	$ 99.34
Unvested at December 31, 2018	759	$ 110.50

(1) "Unvested" represents the Company's 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 2018 and (ii) any change in the number of shares issuable pursuant to outstanding PSUs based on performance certification during 2018.

The total fair value of PSUs that vested during 2018 and 2017 (measured on the date of vesting) was $23.2 million and $1.3 million, respectively. There were no PSUs that vested during 2016, which was the first year that the Company granted PSUs.

Employee Stock Purchase Plan

The Company has 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 the

VERTEX PHARMACEUTICALS INCORPORATED
Notes to Consolidated Financial Statements (Continued)

Company's 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, 2018, there were 402,602 shares of common stock authorized for issuance pursuant to the ESPP.

In 2018, the following shares were issued to employees under the ESPP:

	Year Ended December 31, 2018 (in thousands, except per share amount)
Number of shares	213,654
Average price paid per share	$ 117.52

N. Stock-based Compensation Expense

The Company recognizes 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 and 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. In 2017 and 2018, the expense recognized over the requisite service period was recorded net of the impact for actual awards that were forfeited prior to vesting in accordance with accounting guidance that became effective in January 1, 2017. Prior to adoption of this guidance, the expense recognized included an estimate of awards that would be forfeited prior to vesting.

The effect of stock-based compensation expense during the three years ended December 31, 2018 was as follows:

	2018	2017	2016
	(in thousands)		
Stock-based compensation expense by line item:			
Cost of sales	$4,543	$2,500	$2,918
Research and development expenses	203,112	181,900	153,451
Sales, general and administrative expenses	117,392	108,836	84,254
Total stock-based compensation expense included in costs and expenses	$325,047	$293,236	$240,623

The stock-based compensation expense by type of award during the three years ended December 31, 2018 was as follows:

	2018	2017	2016
	(in thousands)		
Stock-based compensation expense by type of award:			
Stock options	$107,854	$105,367	$114,768
Restricted stock and restricted stock units (including PSUs)	207,845	181,258	118,709
ESPP share issuances	9,933	9,017	7,835
Stock-based compensation expense related to inventories	(585)	(2,406)	(689)
Total stock-based compensation expense included in costs and expenses	$325,047	$293,236	$240,623

The Company capitalizes stock-based compensation expense to inventories, all of which is attributable to employees who support the Company's manufacturing operations for the Company's products.

VERTEX PHARMACEUTICALS INCORPORATED
Notes to Consolidated Financial Statements (Continued)

The following table sets forth the Company's unrecognized stock-based compensation expense as of December 31, 2018, by type of award and the weighted-average period over which that expense is expected to be recognized:

	As of December 31, 2018	
	Unrecognized Expense (in thousands)	Weighted-average Recognition Period (in years)
Type of award:		
Stock options	$155,465	2.64
Restricted stock and restricted stock units (including PSUs)	$321,683	2.58
ESPP share issuances	$5,132	0.58

Stock Options

The Company issues stock options with service conditions, which are generally the vesting periods of the awards. The Company uses 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 the Company's 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 the Company's stock to estimate the fair value of a stock option on the grant date. The options granted during 2018, 2017 and 2016 had a weighted-average grant-date fair value per share of $60.83, $43.27 and $37.93, respectively.

The fair value of each option granted during 2018, 2017 and 2016 was estimated on the date of grant using the Black-Scholes option pricing model with the following weighted-average assumptions:

	2018	2017	2016
Expected stock price volatility	40.50%	45.31%	46.77%
Risk-free interest rate	2.61 %	1.94 %	1.32 %
Expected term of options (in years)	4.55	4.68	4.91
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 the Company's stock with remaining terms of greater than one year that are regularly traded in the market.
- Risk-free interest rate: The Company bases 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. The Company uses historical data to estimate employee exercise and post-vest termination behavior. The Company believes that all groups of employees exhibit similar exercise and post-vest termination behavior and therefore does 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 the Company has not historically paid, and does not intend for the foreseeable future to pay, a dividend.

Restricted Stock, Restricted Stock Units and Performance-based Restricted Stock Units

The Company awards restricted stock and restricted stock units with service conditions, which are generally the vesting periods of the awards. Prior to 2017, the Company also awarded, to certain members of senior management, on an annual basis restricted stock and restricted stock units that vest upon the earlier of the satisfaction of (i) a performance condition or (ii) a service condition.

VERTEX PHARMACEUTICALS INCORPORATED
Notes to Consolidated Financial Statements (Continued)

In February 2016, the Company began granting PSUs to certain members of senior management. Half of the PSUs contain financial goals as the performance metric and the other half contain non-financial goals. A target number of shares was established for each award, however the actual number of shares that are issued when an award vests may range from zero to 200% of the target amount depending upon the level of achievement of the applicable performance metric. The 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. The 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 2018, 2017 and 2016 was $44.04, $35.90 and $26.86, respectively. The following table reflects the weighted-average assumptions used in the Black-Scholes option pricing model for 2018, 2017 and 2016:

	2018	2017	2016
Expected stock price volatility	36.51%	39.09%	48.22%
Risk-free interest rate	2.36 %	1.24 %	0.56 %
Expected term (in years)	0.75	0.75	0.75
Expected annual dividends	—	—	—

The expected stock price volatility for ESPP offerings is based on implied volatility. The Company bases 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 term. The expected term represents purchases and purchase periods that take place within the offering period. The expected annual dividends estimate is $0.00 because the Company has not historically paid, and does not for the foreseeable future intend to pay, a dividend.

O. Income Taxes

The components of income (loss) before (benefit from) provision for income taxes during the three years ended December 31, 2018 consisted of the following:

	2018	2017	2016
	(in thousands)		
United States	$812,086	$330,340	$(147,860)
Foreign	(211,845)	(346,029)	80,494
Income (loss) before (benefit from) provision for income taxes	$600,241	$(15,689)	$(67,366)

On a periodic basis, the Company reassesses the valuation allowance on its deferred income tax assets weighing positive and negative evidence to assess the recoverability of the deferred tax assets. In the fourth quarter of 2018, the Company assessed the valuation allowance and considered positive evidence, including significant cumulative consolidated and U.S. income over the three years ended December 31, 2018, revenue growth, clinical trial data from the Company's triple combination regimens, competitor clinical progress and expectations regarding future profitability, and negative evidence, including the potential impact of competition on the Company's projections and cumulative losses in one of the jurisdictions. After assessing both the positive evidence and the negative evidence, the Company determined it was more likely than not that its deferred tax assets would be realized in the future and released the valuation allowance on the majority of its NOLs and other deferred tax assets as of December 31, 2018, resulting in a benefit from income taxes of $1.56 billion. As of December 31, 2018, the Company maintained a valuation allowance of $168.5 million related primarily to U.S. state and foreign tax attributes.

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Notes to Consolidated Financial Statements (Continued)

The components of the (benefit from) provision for income taxes during the three years ended December 31, 2018 consisted of the following:

	2018	2017	2016
	(in thousands)		
Current taxes:			
United States	$772	$11,559	$(3,821)
Foreign	15,600	3,576	1,794
State	9,018	5,025	1,836
Total current taxes	25,390	20,160	(191)
Deferred taxes:			
United States	(1,105,053)	(113,805)	18,659
Foreign	(364,919)	(3,222)	(3,359)
State	(42,280)	(10,457)	1,556
Total deferred taxes	(1,512,252)	(127,484)	16,856
(Benefit from) provision for income taxes	$(1,486,862)	$(107,324)	$16,665

A reconciliation of the (benefit from) provision for income taxes as computed by applying the U.S. federal statutory rate of 21% for the year ended December 31, 2018 and 35% for the years ended December 31, 2017 and 2016 to the (benefit from) provision for income taxes is as follows:

	2018	2017	2016
	(in thousands)		
Income (loss) before (benefit from) provision for income taxes	$600,241	$(15,689)	$(67,366)
Expected provision for (benefit from) income taxes	126,051	(5,491)	(23,578)
State taxes, net of federal benefit	8,680	4,742	3,621
Foreign income tax rate differential	23,427	77,801	21,346
Tax credits	(52,629)	(58,204)	(47,773)
(Benefit from) provision for income taxes attributable to valuation allowances	(1,563,169)	(575,801)	14,837
Permanent items	1,421	15,324	24,663
Rate change	—	575,192	12,836
Stock compensation (benefit) shortfalls and cancellations	(49,044)	(21,453)	4,162
Officer’s compensation	8,310	6,501	86
Tax attribute expiration	—	—	9,947
Deconsolidation of VIE	(9,390)	(126,183)	—
Uncertain tax positions	15,431	—	—
Other	4,050	248	(3,482)
(Benefit from) provision for income taxes	$(1,486,862)	$(107,324)	$16,665

In 2018, the change in the “(Benefit from) provision for income taxes attributable to valuation allowances” on deferred tax assets in the tax rate reconciliation table above was primarily related to the release of the Company’s valuation allowances on the majority of its NOLs and other deferred tax assets related to the United States and the United Kingdom. In 2017, the valuation allowance decreased by $178.2 million primarily due to the utilization of NOLs in the United States and a decrease in the U.S. federal corporate tax rate from 35% to 21% partially offset by the adoption of ASU 2016-09. In 2016, the valuation allowance increased by $14.8 million primarily due to an increase in tax credits in the U.S. and an increase in the NOL in the United Kingdom.

On December 22, 2017, H.R.1., known as the Tax Cuts and Jobs Act, was signed into law. The new law did not have a significant impact on the Company’s consolidated financial statements for the year ended December 31, 2017. However, the reduction of the U.S. federal corporate tax rate from 35% to 21% resulted in increases to the amounts

reflected in “(Benefit from) provision for income taxes attributable to valuation allowances” and “Rate change” in the Company’s tax

reconciliation table above for the year ended December 31, 2017 compared to the year ended December 31, 2016. The change in the U.S. federal corporate tax rate, which was effective January 1, 2018, is also reflected in the Company's deferred tax table below. Staff Accounting Bulletin No. 118's ("SAB 118") impact on the Company's consolidated financial statements is discussed below.

In 2018 and 2017, "Deconsolidation of VIE" in the Company's tax rate reconciliation above related to the impairments of VX-210 and Parion's pulmonary ENaC platform, respectively, and the decreases in the Company's fair value of the contingent payments to BioAxone and Parion associated with these deconsolidations, respectively. Please refer to Note J, "Intangible Assets and Goodwill," for further information regarding these impairments.

The Company operates in foreign tax jurisdictions, which impose income taxes at different rates than the United States. The impact of these rate differences, which are primarily related to the Company's operations in the United Kingdom, is included in the "Foreign income tax rate differential" in the Company's tax rate reconciliation above. Other items that affected the Company's tax rate reconciliation table were related to equity and executive compensation, research and development credits, Orphan Drug Credits and foreign amortization during the three years ended December 31, 2018.

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,	
	2018	2017
	(in thousands)	
Deferred tax assets:		
Net operating loss	$882,014	$1,004,404
Tax credit carryforwards	487,635	440,429
Intangible assets	241,775	54,091
Deferred revenues	19,311	19,593
Stock-based compensation	93,915	83,196
Accrued expenses	17,795	17,808
Construction financing lease obligation	130,849	109,354
Other	6,831	5,667
Gross deferred tax assets	1,880,125	1,734,542
Valuation allowance	(168,491)	(1,552,942)
Total deferred tax assets	1,711,634	181,600
Deferred tax liabilities:		
Property and equipment	(128,407)	(101,019)
Acquired intangibles	—	(6,341)
Deferred revenue	(73,357)	(73,357)
Unrealized gain	(10,198)	(6,401)
Net deferred tax assets (liabilities)	$1,499,672	$(5,518)

The Company presents its deferred tax assets and deferred tax liabilities gross on its consolidated balance sheets. As of December 31, 2018, the majority of the Company's net deferred tax assets were related to NOLs and tax credit carryforwards. As of December 31, 2017, the Company's net deferred tax liability, which was primarily attributable to the Company's collaboration with BioAxone, was not material to the Company's consolidated financial statements.

As of December 31, 2018, the Company had NOL carryforwards of $2.9 billion and tax credits of $350.7 million for U.S. federal income tax purposes and had NOL carryforwards of $775.5 million and tax credits of $134.9 million for U.S. state income tax purposes. These U.S. federal and state NOL carryforwards and tax credits expire at various dates through 2038 and may be used to offset future federal and state income tax liabilities, respectively. As of

December 31, 2018, the

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Company had foreign net operating loss carryforwards of $942.0 million, including $7.6 million that were subject to expiration and $934.4 million that had an indefinite carryforward period.

Unrecognized tax benefits during the three years ended December 31, 2018 were as follows:

	2018	2017	2016
	(in thousands)		
Balance at beginning of the period	$3,814	$—	$425
Increases related to current period tax positions	9,704	3,814	—
Increases related to prior period tax positions	6,031	—	—
Decrease due to statute limitations	—	—	(425)
Balance at end of period	$19,549	$3,814	$—

As of December 31, 2018, the Company has classified $7.6 million and $11.9 million of its unrecognized tax benefits as credits to “Deferred tax assets” and “Accrued expenses”, respectively on its consolidated balance sheet.

The Company has reviewed the tax positions taken, or to be taken, in its tax returns for all tax years currently open to examination by a taxing authority. Unrecognized tax benefits represent the aggregate tax effect of differences between tax return positions and the benefits recognized in the financial statements. As of December 31, 2018, the Company had $19.5 million of gross unrecognized tax benefits, which would affect the Company's tax rate if recognized. As of December 31, 2017, the Company had $3.8 million of gross unrecognized tax benefits, which would not affect the Company's tax rate if recognized. The Company does not expect that its unrecognized tax benefits will materially increase within the next twelve months. The Company recognizes interest and penalties related to income taxes as a component of its “(Benefit from) provision for income taxes.” As of December 31, 2018, no interest and penalties have been accrued. The Company did not recognize any material interest or penalties related to uncertain tax positions during the three years ended December 31, 2018.

In December 2017, the SEC staff issued SAB 118 to address the application of GAAP in situations when a registrant does not have the necessary information available, prepared, or analyzed (including computations) in reasonable detail to complete the accounting for certain income tax effects of H.R.1. The Company recognized the provisional tax impacts related to deemed repatriated earnings and the revaluation of deferred tax assets and liabilities and included these amounts in its consolidated financial statements for the year ended December 31, 2017. The Company did not record any adjustments in the year ended December 31, 2018 to these provisional amounts that were material to its financial statements. As of December 31, 2018, the Company’s accounting treatment is complete.

As of December 31, 2018, unremitted foreign earnings, which were not significant, have been retained by the Company’s foreign subsidiaries for indefinite reinvestment. Upon repatriation of those earnings, in the form of dividends or otherwise, the Company could be subject to immaterial withholding taxes payable to the various foreign countries.

The Company files U.S. federal income tax returns and income tax returns in various state, local and foreign jurisdictions. The Company is no longer subject to any tax assessment from an income tax examination in the United States or any other major taxing jurisdiction for years before 2011, except where the Company has NOLs or tax credit carryforwards that originate before 2011. The Company currently is under examination in Canada for 2011 through 2013, Germany for 2012 through 2015, Italy for 2015 and 2016 and the United Kingdom for 2015 and 2016. No adjustments have been reported. The Company is not under examination by any other jurisdictions for any tax year.

P. Employee Benefits

The Company has a 401(k) retirement plan (the “Vertex 401(k) Plan”) in which substantially all of its 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. The Company may declare discretionary matching contributions to the Vertex 401(k) Plan. The Company pays matching contributions in the form of cash. For the years ended December 31, 2018, 2017 and 2016, the Company contributed approximately $13.9 million, $12.3 million and $11.8 million to the plan, respectively.

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Q. Commitments and Contingencies

Lease Obligations

For information regarding the Company's lease commitments for its corporate headquarters in Boston, Massachusetts and its location in San Diego, California please refer to Note L, "Long-term Obligations."

As of December 31, 2018, future minimum commitments under the facility leases with initial terms of more than one year were as follows:

Year	Fan Pier Leases	San Diego Lease	Other Leases	Total Lease Commitments
	(in thousands)			
2019	$66,540	$5,324	$13,207	$ 85,071
2020	72,589	9,127	14,270	95,986
2021	72,589	9,127	12,529	94,245
2022	72,589	9,127	12,045	93,761
2023	72,589	9,530	11,952	94,071
Thereafter	389,855	119,864	65,472	575,191
Total minimum lease payments	$746,751	$162,099	$129,475	$ 1,038,325

As of December 31, 2018, the Company's total sublease income to be received related to its facility leases was $6.2 million.

During 2018, 2017 and 2016, rental expense was $17.3 million, $19.2 million and $19.1 million, respectively. The majority of the Company's lease payments related to the Fan Pier Leases are recorded as interest expense because the Company is deemed for accounting purposes to be the owner of the Buildings. Please refer to Note L, "Long-term Obligations," for further information.

The Company has outstanding leases, which are accounted for as capital leases, for equipment and leasehold improvements. The capital leases bear interest at rates ranging from less than 1% to 6% per year. The following table sets forth the Company's future minimum payments due under capital leases as of December 31, 2018:

Year	(in thousands)
2019	$ 10,770
2020	7,282
2021	5,649
2022	3,300
2023	1,974
Thereafter	3,085
Total payments	32,060
Less: amount representing interest	(2,585)
Present value of payments	$ 29,475

In addition, the Company has committed to make potential future milestone and royalty payments pursuant to certain collaboration agreements and an asset acquisition agreement. Payments generally become due and payable upon the achievement of certain developmental, regulatory and/or commercial milestones. Please refer to Note B, "Collaborative Arrangements and Acquisitions," for further information.

Guaranties and Indemnifications

As permitted under Massachusetts law, the Company's Articles of Organization and By-laws provide that the Company will indemnify certain of its 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 the Company could be required to make under

these indemnification provisions is unlimited. However, the Company has purchased directors' and officers' liability insurance policies that could reduce its monetary exposure and enable it to recover a portion of any future amounts paid. No indemnification claims currently are outstanding, and the Company believes the estimated fair value of these indemnification arrangements is minimal.

The Company customarily agrees in the ordinary course of its business to indemnification provisions in agreements with clinical trial investigators and sites in its drug development programs, sponsored research agreements with academic and not-for-profit institutions, various comparable agreements involving parties performing services for the Company, and its real estate leases. The Company also customarily agrees to certain indemnification provisions in its drug discovery, development and commercialization collaboration agreements. With respect to the Company's 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 the Company's contractual obligations arising out of the research or clinical testing of the Company's compounds or drug 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 the Company, to violations of law by the Company or to certain breaches of the Company's contractual obligations. The indemnification provisions appearing in the Company's collaboration agreements are similar to those for the other agreements discussed above, but in addition provide some limited indemnification for its 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 the Company believes 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 the Company could be required to make under these provisions is generally unlimited. The Company has purchased insurance policies covering personal injury, property damage and general liability that reduce its exposure for indemnification and would enable it in many cases to recover all or a portion of any future amounts paid. The Company has never paid any material amounts to defend lawsuits or settle claims related to these indemnification provisions. Accordingly, the Company believes the estimated fair value of these indemnification arrangements is minimal.

Other Contingencies

The Company has certain contingent liabilities that arise in the ordinary course of its business activities. The Company accrues a reserve for contingent liabilities when it is probable that future expenditures will be made and such expenditures can be reasonably estimated. There were no material contingent liabilities accrued as of December 31, 2018 or 2017.

R. Segment Information

Segment reporting is prepared on the same basis that the Company's chief executive officer, who is the Company's chief operating decision maker, manages the business, makes operating decisions and assesses performance. The Company operates 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:

	2018 (as reported under ASC 606)	2017 (as reported under ASC 605)	2016 (as reported under ASC 605)
	(in thousands)		
SYMDEKO/SYMKEVI	$768,657	$—	$—
ORKAMBI	1,262,166	1,320,850	979,590

KALYDECO	1,007,502	844,630	703,432
Other	—	—	610
Total product revenues, net	$3,038,325	$2,165,480	$1,683,632

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Notes to Consolidated Financial Statements (Continued)

Revenues by Geographic Location

Net product revenues are attributed to countries based on the location of the customer. Collaborative and royalty revenues are attributed to countries based on the location of the Company's subsidiary associated with the collaborative arrangement related to such revenues. Total revenues from external customers and collaborators by geographic region consisted of the following:

	2018 (as reported under ASC 606)	2017 (as reported under ASC 605)	2016 (as reported under ASC 605)
	(in thousands)		
United States	$2,365,079	$1,986,786	$1,321,807
Outside of the United States			
Europe	543,179	420,317	320,456
Other	139,339	81,549	59,914
Total revenues outside of the United States	682,518	501,866	380,370
Total revenues	$3,047,597	$2,488,652	$1,702,177

In 2018, 2017 and 2016, revenues attributable to Germany and the United Kingdom contributed the largest amounts to the Company's European revenues.

Significant Customers

Gross revenues and accounts receivable from each of the Company's customers who individually accounted for 10% or more of total gross revenues and/or 10% or more of total gross accounts receivable consisted of the following:

	Percent of Total Gross Revenues			Percent of Gross Accounts Receivable	
	Year Ended December 31,			As of December 31,	
	2018 (as reported under ASC 606)	2017 (as reported under ASC 605)	2016 (as reported under ASC 605)	2018	2017
Walgreen Co.	20 %	17 %	19 %	16 %	20 %
Accredo/Curascript	14 %	14 %	15 %	10 %	12 %
McKesson Corporation	14 %	<10 %	<10 %	16 %	<10 %
CVS/Caremark	n/a	<10 %	19 %	n/a	n/a

Property and Equipment, Net by Location

Property and equipment, net by location consisted of the following:

	As of December 31,	
	2018	2017
	(in thousands)	
United States	$778,157	$753,128
Outside of the United States		

United Kingdom	30,496	31,279
Other	3,352	5,030
Total property and equipment, net outside of the United States	33,848	36,309
Total property and equipment, net	$812,005	$789,437

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Notes to Consolidated Financial Statements (Continued)

S. Quarterly Financial Data (unaudited)

The following table sets forth the Company's quarterly financial data for the two years ended December 31, 2018.

	Three Months Ended			
	March 31, 2018	June 30, 2018	September 30, 2018	December 31, 2018
	(in thousands, except per share amounts)			
Revenues:				
Product revenues, net	$637,729	$749,912	$ 782,511	$ 868,173
Collaborative and royalty revenues	3,070	2,245	2,024	1,933
Total revenues	640,799	752,157	784,535	870,106
Costs and expenses:				
Cost of sales	71,613	104,382	111,255	122,289
Research and development expenses (1)	310,553	337,532	330,510	437,881
Sales, general and administrative expenses	129,808	137,303	137,295	153,210
Restructuring (income) expenses	(76)	62	(174)	4
Intangible asset impairment charge (2)	—	—	—	29,000
Total costs and expenses	511,898	579,279	578,886	742,384
Income from operations	128,901	172,878	205,649	127,722
Interest expense, net	(11,097)	(10,106)	(8,143)	(4,773)
Other income (expense), net (3)	96,838	53,819	(60,995)	(90,452)
Income before (benefit from) provision for income taxes	214,642	216,591	136,511	32,497
(Benefit from) provision for income taxes (4)	(12,659)	10,341	8,055	(1,492,599)
Net income	227,301	206,250	128,456	1,525,096
(Income) loss attributable to noncontrolling interest	(17,038)	1,110	290	25,431
Net income attributable to Vertex	$210,263	$207,360	$ 128,746	$ 1,550,527
Amounts per share attributable to Vertex common shareholders:				
Net income:				
Basic	$0.83	$0.82	$ 0.51	$ 6.08
Diluted	$0.81	$0.80	$ 0.50	$ 5.97
Shares used in per share calculations:				
Basic	253,231	254,135	254,905	254,868
Diluted	258,526	258,584	259,788	259,812

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Notes to Consolidated Financial Statements (Continued)

	Three Months Ended			
	March 31, 2017	June 30, 2017	September 30, 2017	December 31, 2017
	(in thousands, except per share amounts)			
Revenues:				
Product revenues, net	$480,622	$513,988	$ 549,642	$ 621,228
Collaborative and royalty revenues (5)	234,096	30,147	28,523	30,406
Total revenues	714,718	544,135	578,165	651,634
Costs and expenses:				
Cost of sales	46,988	71,205	72,874	84,052
Research and development expenses (6)	273,563	289,451	454,947	306,664
Sales, general and administrative expenses	113,326	127,249	120,710	134,794
Restructuring expenses	9,999	3,523	337	387
Intangible asset impairment charge (7)	—	—	255,340	—
Total costs and expenses	443,876	491,428	904,208	525,897
Income (loss) from operations	270,842	52,707	(326,043)	125,737
Interest expense, net	(16,765)	(14,664)	(13,574)	(12,547)
Other expense, net (7)	(544)	(2,537)	(77,553)	(748)
Income (loss) before provision for (benefit from) income taxes	253,533	35,506	(417,170)	112,442
Provision for (benefit from) income taxes (7)	3,985	4,337	(125,903)	10,257
Net income (loss)	249,548	31,169	(291,267)	102,185
(Income) loss attributable to noncontrolling interest (7)	(1,792)	(13,173)	188,315	(1,501)
Net income (loss) attributable to Vertex	$247,756	$17,996	$ (102,952)	$ 100,684
Amounts per share attributable to Vertex common shareholders:				
Net income (loss):				
Basic	$1.01	$0.07	$ (0.41)	$ 0.40
Diluted	$0.99	$0.07	$ (0.41)	$ 0.39
Shares used in per share calculations:				
Basic	246,024	247,521	250,268	251,557
Diluted	248,700	251,635	250,268	256,804

1. In the fourth quarter of 2018, the Company incurred research and development expenses of $95.0 million to related license agreements with Merck KGaA, Darmstadt, Germany, and Arbor. See Note B, “Collaborative Arrangements and Acquisitions.”
2. In the fourth quarter of 2018, the Company recorded a $29.0 million intangible asset impairment charge related to its VX-210 indefinite-lived in-process research and development asset. See Note J, “Intangible Assets and Goodwill.”
3. In 2018, other income (expense), net was primarily related to changes in the fair value of the Company’s equity investment in CRISPR. See Note E, “Marketable Securities and Equity Investments.”
4. In the fourth quarter of 2018, the Company released the valuation allowance on the majority of its net operating losses and other deferred tax assets as of December 31, 2018 resulting in a benefit from income taxes of $1.56 billion. See Note O, “Income Taxes.”
5. In the first quarter of 2017, the Company recognized $230.0 million of collaborative revenues related to an upfront payment from Merck KGaA, Darmstadt, Germany, pursuant to a collaboration. In each of the second and third quarters of 2017, the Company recognized $20.0 million of collaborative revenues related to payments that Parion, which was a variable interest entity during these periods, received from Shire pursuant to a license agreement. In the fourth quarter of 2017, the Company recognized $25.0 million of collaborative revenues related to a milestone

achieved pursuant to its license agreement with Janssen pursuant to which Janssen is developing pimodivir for the treatment of influenza. See Note B, “Collaborative Arrangements and Acquisitions.”

6. In the third quarter of 2017, the Company incurred research and development expenses of $160.0 million to acquire certain CF assets including VX-561 from Concert. See Note B, “Collaborative Arrangements and Acquisitions.”

7. In the third quarter of 2017, the Company recorded a $255.3 million intangible asset impairment charge related to Parion’s pulmonary ENaC platform indefinite-lived in-process research and development asset, a decrease in the fair value of the contingent payments payable by the Company to Parion of $69.6 million and benefit from income taxes of $126.2 million resulting from these charges. These charges and benefit from income taxes were attributable to noncontrolling interest. See Note B, “Collaborative Arrangements and Acquisitions,” and Note J, “Intangible Assets and Goodwill.”