PFEnex

Pfenex Inc.
Fiscal 2018 Annual Report

About PFE*nex*

We are a clinical-stage development and licensing biotechnology company focused on leveraging our *Pf*ēnex Expression Technology® to develop and improve protein therapies for unmet patient needs. Using the patented *Pf*ēnex Expression Technology platform, we have created an advanced pipeline of potential therapeutic equivalents, vaccines, biologics and biosimilars. We also use our *Pf*ēnex Expression Technology platform to produce CRM197, a diphtheria toxoid carrier protein used in prophylactic and therapeutic vaccines. Our lead product candidates are PF708, a therapeutic equivalent candidate to Forteo® (teriparatide) for the treatment of osteoporosis, and our novel anthrax vaccine candidates, Px563L and RPA563, funded through an advanced development contract with the U.S. government. In addition, we are developing hematology/oncology products, including PF743, a recombinant crisantaspase, and PF745, a recombinant crisantaspase with half-life extension technology, in collaboration with Jazz Pharmaceuticals.

Evert B. Schimmelpennink
Chief Executive Officer

Dear Shareholders,

It has been an exciting and productive 18 months since I joined the Pfenex team as Chief Executive Officer. During this time, we have prioritized our development pipeline, with a specific focus on key assets capable of transitioning the company into a commercial business and driving growth. As a result of this strategy, we believe we are working to unlock significant opportunity from our programs, and are on our way to delivering value to our stockholders in 2019 and beyond.

Our strategy is focused on advancing four key opportunities in our pipeline, including our PF708, our Jazz partnership, our anthrax vaccine candidates funded by BARDA, and our CRM197 partnerships with Merck and Serum Institute of India.

- **Our lead product candidate, PF708, is being developed as a therapeutic equivalent to Forteo® (teriparatide),** which is marketed by Eli Lilly for the treatment of osteoporosis patients at high risk of fracture. In February 2019, the U.S. Food and Drug Administration (FDA) accepted the new drug application (NDA) we filed for PF708 and provided a PDUFA date of October 7, 2019. The NDA includes, among other data, positive Phase III clinical data that we had announced in mid-2018, which showed comparable overall profiles between PF708 and Forteo after 24 weeks of daily injection in osteoporosis patients. We believe PF708 is on track for a commercial launch in the United States as early as the fourth quarter of 2019, subject to FDA approval and other factors.

  Subject to applicable regulatory approvals, our commercialization strategy for PF708 includes a development and licensing agreement with Alvogen for the U.S., EU, certain countries in Middle East and North Africa (MENA), and to the majority of the remaining ROW territories. This collaboration aligns the interests and strengths of both companies to secure regulatory approvals and commercializing PF708, including Alvogen's established international experience and expertise in regulatory, IP and supply chain activities, as well as its established network of specialty marketing and sales pharmaceutical companies in these regions. We are eligible to receive a gross profit split of up to 50% on U.S. product sales if PF708 is rated as Therapeutic

Equivalent (AP), and up to 40% if rated differently, as well as up to 60% for EU, MENA and ROW product sales depending on geography and cost of goods sold. We also have an exclusive license agreement with NT Pharma to commercialize PF708 in Mainland China, Hong Kong, Singapore, Malaysia and Thailand and a non-exclusive license to conduct development activities in such territories with respect to PF708.

• **Our Collaboration with Jazz Pharmaceuticals Ireland Limited (Jazz) continues to demonstrate how our platform is uniquely enabling.** We have completed the process development of PF743, a recombinant crisantaspase, and the development is ongoing for PF745, a recombinant crisantaspase with half-life extension technology. The success of these programs to date demonstrates the unique enabling abilities of our platform technology.

Through December 31, 2018, we have received approximately $36 million under the Jazz agreement. We expect these programs will be eligible to achieve certain development milestones in 2019. Currently, we are eligible to receive an aggregate total of $224.5 million in development and sales milestone fees, of which $188.5 million is still eligible to be received. Of this $188.5 million, $29.5 million are development milestones, $34.0 million are regulatory milestones and $125.0 million are sales milestones. We may also be eligible to receive tiered royalties on worldwide sales of any products resulting from the collaboration.

• **Our CRM197, a well characterized protein that functions as a carrier for polysaccharides and haptens making them immunogenic.** In 2018, we announced clinical updates and milestone payments from our development and commercial partners, including Merck and the Serum Institute of India.

In 2018, Merck announced that it initiated three Phase 3 studies of its PCV-15 (V114), an investigational polyvalent conjugate vaccine for the prevention of pneumococcal disease, using CRM197. In January of 2019, Merck announced that it received Breakthrough Therapy Designation from the FDA for the prevention of invasive pneumococcal disease (IPD) caused by the vaccine serotypes in pediatric patients 6 weeks to 18 years of age. We are eligible to receive annual fees, milestone payments and a tiered royalty based on net sales for all products developed by Merck that use the CRM197 produced via our *Pf*ēnex Expression Technology platform.

We also have a partnership with the Serum Institute of India (SII), the world's largest vaccine manufacturer, producing more than 1.3 billion doses in 2017 and distributing them to over 170 countries. SII announced that the SII vaccine, Pneumosil®, which uses CRM197, recently completed a Phase 3 program in which all primary and secondary objectives were met and SII received an export license for Pneumosil. The commercial market is expected to include India, Asia, Africa and other low- and middle-income countries under the Gavi Advanced Market Commitment (AMC). Pfenex is eligible to receive annual fees, milestone payments, and a tiered low single digit royalty based on net sales for all products developed by SII that use the CRM197 carrier protein produced via the *Pf*ēnex Expression Technology.

We also have other partnerships in various stages and continue to sell non-GMP and cGMP grade CRM197 to vaccine development-focused pharma partners.

• **Our U.S. government funded Anthrax vaccine development programs are another illustration of the versatility of Pfenex capabilities.** Px563L and RPA563 are novel anthrax vaccine candidates that we are developing in response to the United States government's unmet demand for increased quantity, stability and dose sparing regimens of anthrax vaccine. These programs are funded by the U.S. Government under a $145.2 million advanced development contract with BARDA. In December 2018, we held a Type C meeting with the FDA to discuss Px563L's potency release method. In January 2019, we had an In-Process Review (IPR) meeting with the Public Health Emergency Medical Countermeasures Enterprise (PHEMCE) Milestone Decision Authority (MDA). We believe that these two meetings are helping to create a pathway that could potentially trigger the next option periods for GMP manufacturing and preparation for a Phase 1b/2 study in late 2019, subject in each case to continued funding by BARDA.

We will aim to drive additional growth by growing our *Pf*ēnex Expression Technology-based partnered portfolio. We believe that the *Pf*ēnex Expression Technology represents a competitive advantage in the biopharmaceutical industry and we will seek to further exploit the platform through additional collaborations where the platform is uniquely enabling. To that end we are continuing our business and corporate development efforts seeking new collaborations.

Considering all the activities I have described, we believe that Pfenex is at a transformational point in its history as we see several programs in late-stage studies and regulatory review that could drive our growth. These opportunities have ramped up quickly and are examples that our team is capable of executing on its strategy in moving Pfenex towards a commercial business. I look forward to continuing leading the team and building long-term value for our stockholders.

Evert B. Schimmelpennink
Chief Executive Officer

March 11, 2019

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

FORM 10-K

(Mark One)

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

For the fiscal year ended December 31, 2018

OR

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

For the transition period from to
Commission file number: 001-36540

Pfenex Inc.

(Exact name of registrant as specified in its charter)

Delaware	**27-1356759**
(State or other jurisdiction of incorporation or organization)	**(I.R.S. Employer Identification Number)**
10790 Roselle Street San Diego, California	**92121**
(Address of principal executive offices)	**(Zip Code))**

Registrant's telephone number, including area code: (858) 352-4400

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

Common Stock, par value $0.001 per share	**NYSE American LLC**
(Title of each class)	**(Name of each exchange on which registered)**

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

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

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

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

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

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

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

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

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

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

The aggregate market value of the voting and non-voting common stock held by non-affiliates of the registrant, based on the closing sale price of the Registrant's common stock on the last business day of its most recently completed second fiscal quarter, as reported on NYSE American, was approximately $169.3 million. Shares of common stock held by each executive officer and director and by each other person who may be deemed to be an affiliate of the Registrant, have been excluded from this computation. The determination of affiliate status for this purpose is not necessarily a conclusive determination for other purposes.

As of March 1, 2019, there were 31,485,199 shares of the registrant's common stock, $0.001 par value, outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's Proxy Statement for its Annual Meeting of Stockholders are incorporated by reference in Part III of this Annual Report on Form 10-K where indicated. Such Proxy Statement will be filed with the Securities and Exchange Commission within 120 days of the registrant's fiscal year ended December 31, 2018.

Pfenex Inc.

Annual Report on Form 10-K

For the Fiscal Year Ended December 31, 2018

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SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K contains 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, which are subject to the "safe harbor" created thereunder and which involve substantial risks and uncertainties. Forward-looking statements generally relate to future events or our future financial or operating performance. In some cases, you can identify forward-looking statements because they contain words such as "may," "will," "should," "expects," "plans," "anticipates," "could," "intends," "target," "projects," "contemplates," "believes," "estimates," "predicts," "potential" or "continue" or the negative of these words or other similar terms or expressions that concern our expectations, strategy, plans or intentions. Forward-looking statements contained in this Annual Report on Form 10-K include, but are not limited to, statements about:

- the sufficiency of our cash and cash equivalents and cash generated from operations to meet our working capital and capital expenditure needs for the next 12 months, including our belief that we have sufficient cash resources to fund all necessary activities leading up to and including meeting our obligations to contractually support our partner on the potential commercial launch of PF708 in the United States as early as the fourth quarter of 2019, subject to FDA approval of the new drug application and other factors;
- our and any potential future collaboration partner's ability to enroll patients in our clinical studies at the pace that we project;
- our expectations regarding the initiation, timing, progress and the success of the design, primary and secondary end points, and duration of the clinical trials and planned clinical trials of PF708, Px563L, RPA563 and our other product candidates, and reporting results from same;
- whether the results of our and our collaboration partners' trials will be sufficient to support domestic or global regulatory filings and approvals for PF708, including our expectations regarding the timing of receipt of approval by FDA of our NDA submitted in December 2018 for PF708;
- our ability to seek, obtain and maintain regulatory approval of PF708 or our other product candidates, and the timing of such potential regulatory approvals;
- our ability to obtain an FDA determination that PF708 is therapeutically equivalent to Forteo;
- our expectations regarding the earliest potential commercial launch of PF708 in the United States;
- our reliance on third-parties to conduct clinical studies;
- our reliance on third-party contract manufacturers and Alvogen to manufacture and supply our product candidates for us;
- the benefits of the use of PF708, Px563L, RPA563 or any of our other product candidates;
- the rate and degree of market acceptance of PF708, Px563L, RPA563 or any of our other product candidates, if approved for sale;
- regulatory developments in the United States and foreign countries;
- our expectations regarding government and third-party payor coverage and reimbursement;
- our and our collaboration partners' ability to manufacture PF708, Px563L, RPA563 and our other product candidates in conformity with regulatory requirements and to scale up manufacturing of PF708, Px563L, RPA563 and our other product candidates to commercial scale;
- our ability to successfully build a specialty sales force, or collaborate with third-parties including our existing collaboration partners, Alvogen and NT Pharma, to commercialize PF708 and our other product candidates;
- our and Alvogen's ability to compete with companies currently producing the reference products, including Forteo;

- our ability to compete with companies that may also seek and obtain approval for therapeutically equivalent versions of Forteo;
- our reliance on Jazz, Alvogen, NT Pharma and any future collaboration partner's performance over which we do not have control;
- our ability to retain and recruit key personnel, including development of a sales and marketing function;
- our ability to obtain and maintain intellectual property protection for PF708, Px563L, RPA563 or any other product candidates;
- our estimates of our expenses, ongoing losses, future revenue, capital requirements and our needs for or ability to obtain additional financing;
- our expectations regarding the market size, size of patient populations, and growth potential for our product candidates, if approved for commercial use;
- our estimates of the expected patent expiration timelines for Forteo and other branded reference drugs and biologics;
- our expectations regarding the time during which we will be an emerging growth company under the Jumpstart Our Business Startups Act;
- our ability to develop new products and product candidates;
- our ability to successfully establish and successfully maintain appropriate collaborations and derive significant revenue from those collaborations;
- our financial performance; and
- developments and projections relating to our competitors and our industry.

We caution you that the foregoing list may not contain all of the forward-looking statements made in this Annual Report on Form 10-K.

You should not rely upon forward-looking statements as predictions of future events. We have based the forward-looking statements contained in this Annual Report on Form 10-K primarily on our current expectations and projections about future events and trends that we believe may affect our business, financial condition, results of operations, and prospects. The outcome of the events described in these forward-looking statements is subject to risks, uncertainties, and other factors described in the section titled "Risk Factors" and elsewhere in this Annual Report on Form 10-K. Moreover, we operate in a very competitive and rapidly changing environment. New risks and uncertainties emerge from time to time, and it is not possible for us to predict all risks and uncertainties that could have an impact on the forward-looking statements contained in this Annual Report on Form 10-K. We cannot assure you that the results, events, and circumstances reflected in the forward-looking statements will be achieved or occur, and actual results, events, or circumstances could differ materially from those described in the forward-looking statements.

The forward-looking statements made in this Annual Report on Form 10-K are based on information available to us on the date of this Annual Report on Form 10-K. In addition, statements that "we believe" and similar statements reflect our beliefs and opinions on the relevant subject. These statements are based upon information available to us as of the date of this Annual Report on Form 10-K, and although we believe such information forms a reasonable basis for such statements, such information may be limited or incomplete, and our statements should not be read to indicate that we have conducted a thorough inquiry into, or review of, all potentially available relevant information. These statements are inherently uncertain and investors are cautioned not to unduly rely upon these statements.

We undertake no obligation to update any forward-looking statements made in this Annual Report on Form 10-K to reflect events or circumstances after the date of this Annual Report on Form 10-K or to reflect new information or the occurrence of unanticipated events, except as required by law. We may not actually achieve the plans, intentions, or expectations disclosed in our forward-looking statements and you should not place undue reliance on our forward-looking statements. Our forward-looking statements do not reflect the potential impact of any future acquisitions, mergers, dispositions, joint ventures, or investments we may make.

This Annual Report on Form 10-K also contains estimates, projections and other information concerning our industry, our business, and the markets for certain diseases, including data regarding the estimated size of those markets, and the incidence and prevalence of certain medical conditions. Information that is based on estimates, forecasts, projections, market research or similar methodologies is inherently subject to uncertainties and actual events or circumstances may differ materially from events and circumstances reflected in this information. Unless otherwise expressly stated, we obtained this industry, business, market, and other data from reports, research surveys, studies, and similar data prepared by market research firms and other third parties, industry, medical and general publications, government data, and similar sources.

*Pfē*nex™ and *Pfē*nex Expression Technology® are our primary trademarks. This Annual Report on Form 10-K contains these trademarks and some of our other trademarks, trade names and service marks. Each trademark, trade name or service mark of any other company appearing in this Annual Report on Form 10-K belongs to its respective holder.

As used in this Annual Report on Form 10-K, the terms “the Company,” “we,” “us” and “our” refer to Pfenex Inc. and its subsidiaries, unless the context indicates otherwise.

PART I

Item 1. *Business*

Overview

We are a clinical-stage development and licensing biotechnology company focused on leveraging our *Pf*ēnex Expression Technology to develop and improve protein therapies for unmet patient needs. Using the patented *Pf*ēnex Expression Technology platform, we have created an advanced pipeline of potential therapeutic equivalents, vaccines, biologics and biosimilars. We also use our *Pf*ēnex Expression Technology platform to produce CRM197, a diphtheria toxoid carrier protein used in prophylactic and therapeutic vaccines candidates under development by third parties. Our lead product candidates are PF708, under development as a therapeutic equivalent drug candidate to Forteo® (teriparatide) for the treatment of osteoporosis, and our novel anthrax vaccine candidates, Px563L and RPA563, funded through an advanced development contract with the U.S. government. In December 2018, we submitted our new drug application (NDA) for PF708 to the FDA and the FDA accepted the submission for substantive review in February 2019. In April 2018, we granted certain development and commercialization rights for PF708 in certain Asian countries to China NT Pharma Group Company Limited (NT Pharma). In June 2018, we granted Alvogen, through certain of its subsidiaries (together, Alvogen), exclusive rights to commercialize and manufacture PF708 in the United States. In February 2019 we granted Alvogen exclusive rights to commercialize and manufacture PF708 in the European Union (EU), certain countries in the Middle East and North Africa (MENA) and the rest of the world other than the territory covered by our agreement with NT Pharma. In addition, we are developing hematology/oncology products in collaboration with Jazz Pharmaceuticals Ireland Limited (Jazz).

Product Candidates and Collaborations

The following table summarizes certain information about our lead product candidates and collaborations:

Product Candidate	Branded Reference Drug	Program	Proposed Indication
Proposed Therapeutic Equivalent			
PF708—Teriparatide	Forteo	• Licensed in the United States, EU, MENA, and Rest of World to Alvogen • Licensed in Mainland China, Hong Kong, Singapore, Malaysia, Thailand to NT Pharma	Osteoporosis
Multiple Hematology/Oncology Product Candidates	Various	• Jazz Pharmaceuticals Ireland Limited	Various
Novel Vaccines			
Px563L and RPA563—rPA based anthrax vaccines	N/A	• U.S. Government Funded	Anthrax post-exposure prophylaxis

Our lead product candidates and collaborations include the following:

- **PF708—our teriparatide drug candidate.** PF708 is being developed as a therapeutic equivalent candidate to Forteo, which is approved and marketed by Eli Lilly and Company for the treatment of osteoporosis in certain patients with a high risk of fracture. Forteo achieved $1.6 billion in global product sales in 2018. PF708 is being developed pursuant to the 505(b)(2) regulatory pathway in the U.S. and references Forteo as the Reference Listed Drug. In November 2017, we announced the interim pharmacokinetic (PK) results from Study PF708-301, which compared the effect of PF708 and Forteo in osteoporosis patients. In May 2018, we announced positive top-line results from our PF708-301 study, which showed comparable overall safety and efficacy profiles between PF708 and Forteo after 24 weeks of daily injection in osteoporosis patients.

The PF708-301 study enrolled a total of 181 patients, with 90 patients receiving PF708 and 91 patients receiving Forteo. There were 82 patients who completed the study in the PF708 treatment group, compared with 81 patients in the Forteo treatment group. The primary study endpoint was anti-drug antibody (ADA) incidence after 24 weeks of drug treatment. The secondary study endpoints included mean percentage changes in lumbar-spine bone mineral density (BMD) and median percentage changes in bone turnover markers (BTM) after 24 weeks of drug treatment, as well as pharmacokinetic (PK) parameters for up to four hours after the first dose. Safety study endpoints were incidences of adverse events (AE) and serious adverse events (SAE).

There were two PF708-treated patients and two Forteo-treated patients that developed ADA during the study. These low rates of immunogenicity are consistent with historical Forteo results (~3%) in postmenopausal osteoporosis patients. At Week 24, there were two ADA-positive findings for PF708 compared with none for Forteo, but the difference was not statistically significant. The ADA findings in the two PF708 patients were low in titer and resolved during follow-up. One of the two patients had *in vitro* neutralizing activity transiently detected at Week 4. However, pharmacological activity, as assessed by increases in BMD and BTM, was observed during the study for this patient. There were no apparent safety issues or abnormal serum calcium levels related to ADA or neutralizing antibody findings. These findings are consistent with observations in similar follow-on products approved in the United States, with almost all of the products demonstrating an ADA treatment difference of less than 5% in comparative patient studies. The overall ADA results are shown in Table 1, and individual titer results for all ADA-positive patients are shown in Table 2 (below).

PF708 and Forteo demonstrated comparable effects on lumbar-spine BMD, P1NP (N-terminal propeptide of type 1 procollagen), which is a marker of bone formation and CTX (cross-linked C-terminal telopeptide of type 1 collagen), which is a marker of bone resorption. There were no statistically significant differences in any of these parameters between PF708 and Forteo. The lumbar-spine BMD results are shown in Figure 1 (below), and BTM results are shown in Figure 2 (below).

There were no significant imbalances in AE incidences or severity profiles between PF708 and Forteo. Treatment-emergent AE and SAE profiles are shown in Table 3 (below), and the severity of treatment-emergent AEs is shown in Table 4 (below).

The PF708-301 study assessed PF708 and Forteo across multiple endpoints in both female and male osteoporosis patients and showed comparable overall profiles. We believe the PF708-301 and PF708-101 study results meet the requirements for demonstrating clinical safety, effectiveness and bioequivalence. These results from the PF708-301 study, along with the previously announced bioequivalence findings from the PF708-101 study in healthy subjects, supported the PF708 NDA submission. In July 2018 we had a constructive Pre-NDA meeting with the FDA which confirmed there were no additional clinical, nonclinical or analytical comparability studies requested by the FDA. We filed our NDA in December 2018 and the FDA accepted our NDA in February 2019 for substantive review, which we believe puts us on-track for a potential commercial launch in the United States as early as the fourth quarter of 2019, subject to FDA approval of the application and other factors.

PF708 is being developed pursuant to the 505(b)(2) regulatory pathway in the U.S. and references Forteo as the Reference Listed Drug. While we believe our application strategy could lead to launch in the U.S. as early as the fourth quarter of 2019, subject to FDA approval of the application, it is possible that various factors, including patent litigation by Eli Lilly and Company, may delay approval and launch. We believe that our existing cash and cash equivalents and our cash inflow from operations will be sufficient to meet our anticipated cash needs for at least the next 12 months, including to fund all necessary activities leading up to and including meeting our obligations to contractually support our partner on the potential commercial launch in the United States as early as the fourth quarter of 2019, subject to FDA approval of the NDA and other factors. We believe the clinical program in the U.S. may be leveraged for regulatory filings in other geographies, such as the European Union (EU).

Table 1. Study PF708-301 Overall Anti-Drug Antibody Results

Time (wk)	PF708		Forteo		P value
0	0/90	0%	0/91	0%	1.00
1	1/87	1.2%	0/90	0%	0.49
4	1/86	1.2%	0/89	0%	0.49
12	2/82	2.4%	2/86	2.3%	1.00
24	2/81	2.5%	0/81	0%	0.50
24 week overall	2/87	2.3%	2/90	2.2%	1.00

Table 2. Study PF708-301 Anti-Drug Antibody Titer Results for Individual Patients

Time (wk)	PF708 Patient 1	PF708 Patient 2	Forteo Patient 1	Forteo Patient 2
0	Neg	Neg	Neg	Neg
1	1:1	Neg	Neg	Neg
4	1:1*	Neg	Neg	Neg
12	1:1	1:1	1:8	1:2
24	1:1	1:1	Neg	Neg
Follow-up	Neg	Neg	N/A	N/A

* In vitro neutralizing activity detected; pharmacological activity, as assessed by changes in BMD and BTM, was observed during the study for this patient.

Antibody titer measures how much ADA is present in a positive sample. A value of 1:1 is the lowest possible finding, whereas a value of 1:8 represents an 8-fold increase.

Neg: negative; N/A: not applicable

Table 3. Study PF708-301 Treatment-Emergent Adverse Event Profiles

Number and Percent of Patients with:	PF708		Forteo	
Any AE	75	83.3%	73	80.2%
Any SAE	6	6.7%	8	8.8%
Any treatment-related AE	48	53.3%	45	49.5%
Any AE leading to early withdrawal	3	3.3%	5	5.5%
Any AE leading to death	0	0%	0	0%

AE: adverse event; SAE: serious adverse event

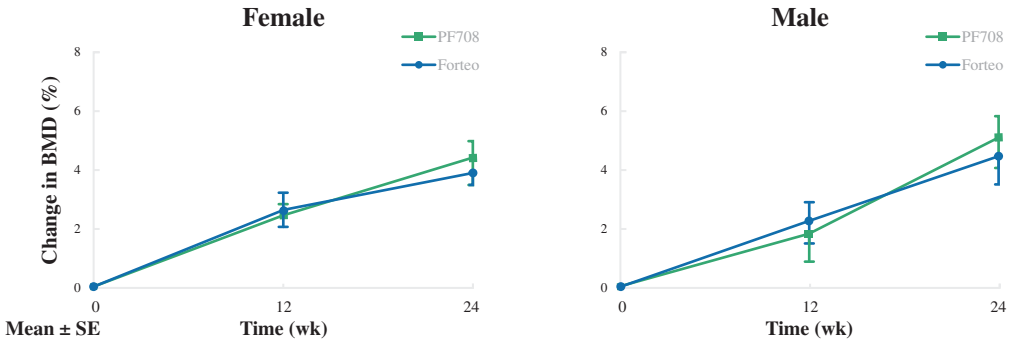
Table 4. Study PF708-301 Severity of Treatment-Emergent Adverse Events

		Grade 1	Grade 2	Grade 3	Grade 4	Total
All Findings	PF708	169	84	6	2	261
	Forteo	203	61	9	3	276
		Grade 1	**Grade 2**	**Grade 3**	**Grade 4**	**Total**
Injection Site Findings	PF708	36	1	0	0	37
	Forteo	33	1	0	0	34

Severity of AEs was assessed according to the Common Terminology Criteria for Adverse Events. Version 4.03

Figure 1. Study PF708-301 Lumbar-Spine Bone Mineral Density Results in Female and Male Patients

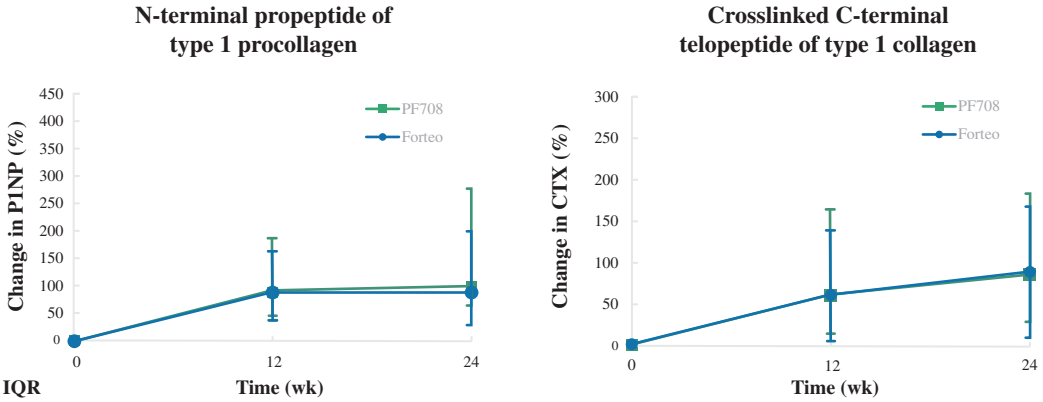
Lumbar-Spine (L1-L4)



Mean ± SE

No. of subjects						
PF708	60	60	58	23	23	23
Forteo	62	61	59	22	22	20

Figure 2. Study PF708-301 Bone Turnover Markers Results in All Patients



Median ± IQR

No. of patients						
PF708	85	79	78	80	79	76
Forteo	85	84	80	86	85	79

IQR: interquartile range

In June 2018, we and Alvogen entered into a Development and License Agreement (US Alvogen Agreement) pursuant to which Alvogen has the exclusive right to commercialize and manufacture PF708 in the United States. In February 2019 we and Alvogen expanded our collaboration to develop and commercialize PF708 in the EU, certain countries in the Middle East and North Africa (MENA), and the ROW territories (the latter defined as all countries outside of the EU, US and MENA, excluding Mainland China, Hong Kong, Singapore, Malaysia and Thailand). We believe this collaboration leverages Alvogen's established international experience and expertise in regulatory, IP and supply chain activities, as well as its established network of specialty marketing and sales pharmaceutical companies in these regions. Subject to applicable regulatory approvals, PF708 will be commercialized in Europe and Switzerland by Theramex, a leading global specialty pharmaceutical company dedicated to Women's Health, in MENA by SAJA, a Tamer Group company, and in ROW by Alvogen's current and/or future commercialization partners. Under the terms of the agreements,

Alvogen will be responsible for the local activities through Theramex, SAJA and its other commercialization partners and for overseeing any clinical development, regulatory, litigation, commercial manufacturing and commercialization. We are eligible to receive additional upfront and milestone payments of $2.5 million for the EU and MENA and additional potential milestone payments for ROW. For EU, MENA and ROW, we may also be eligible to receive a gross profit split of up to 60% on product sales, if approved, depending on geography and cost of goods sold.

In April 2018, we and NT Pharma entered into a Development and License Agreement (NT Pharma Agreement), pursuant to which we granted an exclusive license to NT Pharma to commercialize PF708 in Mainland China, Hong Kong, Singapore, Malaysia and Thailand and a non-exclusive license to conduct development activities in such territories with respect to PF708. In accordance with the agreement, we received a payment of $2.5 million upon signing the NT Pharma Agreement and may be eligible to receive additional payments of up to $22.5 million based on the achievement of certain development, regulatory, and sales-related milestones. We may also be eligible to receive double-digit royalties on net sales of PF708. NT Pharma is responsible for any further development required to achieve regulatory approval as well as commercialization activities in the applicable territories.

- **Jazz Collaboration—multiple early stage hematology/oncology product candidates with Jazz.** In July 2016, we entered into a license and option agreement with Jazz, pursuant to which we and Jazz are collaboratively developing hematology/oncology products, including PF743, a recombinant crisantaspase, and PF745, a recombinant crisantaspase with half-life extension technology, and Jazz will have the exclusive right to manufacture and commercialize such products throughout the world. In addition, pursuant to the agreement, we have granted Jazz certain other rights to negotiate the exclusive right to develop, manufacture and commercialize throughout the world other hematology/oncology products that are currently or in the future may be developed by us. In the third quarter of 2017, we achieved a process development milestone associated with this collaboration. In December 2017, we and Jazz signed an amended and restated agreement under which we will be eligible to receive an additional $43.5 million in amendment fee and development milestone payments as compared to the 2016 agreement, increasing the total value of upfront, option and amendment fee payments and potential payments for the achievement of development, regulatory and sales-related milestones associated with the collaboration to an aggregate of $224.5 million. We will also continue to be eligible to receive tiered royalties on worldwide sales of any products resulting from the collaboration at rates reduced from those under the 2016 agreement. In December 2017, as part of the amended and restated agreement, we received a total payment of $18.5 million, consisting of an upfront payment of $5.0 million and a payment of $13.5 million for development achievement. In the second quarter of 2018, we achieved two development milestones and received $750 thousand for successful achievement of process development milestones for PF745.
- **Px563L and RPA563—our two novel anthrax vaccine candidates funded by the Biomedical Advanced Research and Development Authority (BARDA)**. Both vaccine candidates are prepared using the identical antigen and are being evaluated in parallel, although Px563L contains an adjuvant and RPA563 does not. In August 2016, we announced positive immunogenicity and safety data from Day 70 analysis of the Px563L and RPA563 anthrax vaccine study. The Px563L results indicated that the vaccine was well-tolerated and afforded immunogenicity protection with fewer doses than the currently licensed product. We announced positive interim results from a Phase 1a study in healthy subjects in the second half of 2016 and the study was completed in the first half of 2017. We have generated stability data on the 2016 manufactured lot for up to 12 months, which demonstrated the maintenance of high purity at 5°C, the expected storage temperature, and accelerated stability data at 25°C. We have also generated long-term stability data from our toxicology lot, showing the maintenance of high purity at 5°C at 40 months. Over the course of 2018, we continued to collect favorable stability data for both products and also completed feasibility studies that demonstrated the compatibility of both products with the USP compendial relative potency method for anthrax. In addition, we completed adjuvant manufacturing optimization and bulk drug substance manufacturing

process establishment runs at the commercial contract manufacturer. In October 2017, we completed a meeting with the FDA in which the FDA provided guidance for the proposed clinical development and licensure plans for a post-exposure prophylaxis indication. In 2017, BARDA exercised additional options under its existing contract, allowing for the continued development of Px563L and RPA563. One of the exercised options was increased by $1.7 million in May 2018, which increased the total contract value to $145.2 million. In September 2018, BARDA extended the contract period of performance. In 2018, we completed non-clinical animal studies and related analytical work. In December of 2018, we conducted a Type C meeting, with the FDA to discuss the preliminary studies completed with a potency method adapted from the USP relative potency method for anthrax vaccine adsorbed (AVA). The FDA response was that the data generated from the preliminary studies in guinea pigs are encouraging and offered to review protocols and statistical approach for both qualification and validation of the method going forward. In January of 2019 we held an In Process Review (IPR), meeting with the Public Health Emergency Medical Countermeasures Enterprise (PHEMCE) Milestone Decision Authority (MDA). Potential next milestones are the triggering of analytical and non-clinical animal study options, leading to a potential Phase 1b/2 study in 2019, subject in each case to continued funding by BARDA. We believe the successful completion of the Phase 2 study and activities under our development contract with BARDA could lead to a procurement contract for supply of Px563L or RPA563 to the Strategic National Stockpile.

- **CRM197**—We have both licenses and supply agreements in place for CRM197, which is a non-toxic mutant of diphtheria toxin. It is a well-characterized protein and functions as a carrier for polysaccharides and haptens, making them immunogenic. We developed a unique CRM197 production strain based on our *Pseudomonas fluorescens* platform and sell non-GMP and cGMP CRM197 to vaccine development-focused pharmaceutical partners. As a result of our development efforts, we previously entered into commercial licenses for production strains capable of producing CRM197 with both Merck & Co., Inc. (Merck) and Serum Institute of India Private Ltd., (SIIPL). Our CRM197 is currently being used in Merck's Phase 3 study for PCV-15 (V114), an investigational 15-valent polyvalent conjugate vaccine for the prevention of pneumococcal disease. In June 2018, Merck began the first Phase 3 study of PCV-15 (V114) which will evaluate the safety, tolerability and immunogenicity followed by Pneumococcal Vaccine Polyvalent one year later in healthy adult subjects 50 years of age or older, for which we earned a milestone payment. Two additional Phase 3 studies started in July 2018. One will evaluate the safety, tolerability and immunogenicity of PCV-15 (V114) followed by Pneumococcal Vaccine Polyvalent administered eight weeks later in adults infected with HIV, and the other will evaluate the safety, tolerability, and immunogenicity of PCV-15 (V114) in adults ages 18 to 49 at increased risk for pneumococcal disease. In January of 2019, Merck announced that it received Breakthrough Therapy Designation from the FDA for the prevention of invasive pneumococcal disease (IPD) caused by the vaccine serotypes in pediatric patients 6 weeks to 18 years of age. We are eligible to receive annual fees, milestone payments and a tiered royalty based on net sales for all products developed by Merck that use the CRM197 produced via the *Pf*ēnex Expression Technology platform. Our CRM197 is also currently being used by SIIPL who is developing a 10-valent pneumococcal conjugate vaccine, Pneumosil. The SIIPL vaccine recently completed a Phase 3 study in which SIIPL reported that all primary and secondary objectives were met. Following review of the Complete Study Report and product dossier by the Drug Controller General of India (DCGI) SIIPL has received an export license for Pneumosil. SIIPL has already initiated the process of World Health Organization (WHO) prequalification for Pneumosil. The PQ process could take up to 12 months to complete. The commercial market if the product is approved will include India and the developing world, covering over 71% IPD causing serotypes, and targeting the Indian UIP and Asian, African and other low- and middle-income countries under the Gavi Advanced Market Commitment (AMC). A second product being developed by SIIPL that is subject to the Pfenex Expression Technology license is a thermostable Pentavalent Meningococcal Conjugate Vaccine (A, C, Y, W-135, X), which also utilizes CRM197 as one of its carrier proteins. This product which is expected to enter

in a Phase 3 study and is also targeted for developing countries. For both products we are eligible to receive a tiered royalty based upon net sales by SIIPL pursuant to regulatory approval.

- **Additional Biosimilar Pipeline Products**—Our pipeline includes biosimilar candidates to certain reference products, including biosimilar candidates to Lucentis and Neulasta. Following our strategic review in November 2017, we decided to pause development activities on PF582, our biosimilar candidate to Lucentis and PF529, our biosimilar to Neulasta, and focus development efforts elsewhere within the product portfolio while we continue to engage potential strategic partners to advance the programs and maximize value. We do not intend to advance our current biosimilar candidates without development and commercial collaboration partners.

To date, none of our product candidates, other than PF708, has completed clinical development or been submitted for regulatory review, and none of our product candidates has received marketing authorization from any regulatory agency. Therefore, we have not received revenue from the sale of any of our product candidates. Our product candidates are enabled by our patented protein production platform, *Pf*ēnex Expression Technology, which we believe confers several important competitive advantages compared to traditional techniques for protein production, including the ability to produce complex proteins with higher accuracy and greater degree of protein purity, as well as speed and cost advantages. The development of proteins requires several competencies which represent both challenges and barriers to entry. Due to their inherent complexity, proteins require the use of living organisms to efficiently produce them at a large scale. Traditional techniques for protein production employ a trial and error approach to production organism, or strain, selection and process optimization, which is inherently inefficient and typically produces suboptimal results. This historically inefficient process provides barriers to creating or replicating complex proteins, adds significant time to market and results in the high cost of goods typical of biologic therapeutics. Together, these limitations pose significant hurdles for companies interested in entering the market with novel biologics, biosimilars and therapeutic equivalents. Our platform utilizes a proprietary high throughput robotically-enabled parallel approach, which allows the construction and testing of thousands of unique protein production strains in parallel, thereby allowing us to produce and characterize complex proteins while reducing the time and cost of development and long-term production.

The potential market opportunities for our most advanced product candidate, PF708, are substantial. We have developed PF708 as a therapeutic equivalent candidate to Forteo, which achieved product sales of approximately $1.6 billion in 2018. Almost half of these product sales came from the U.S. alone. In 2019, Forteo is expected to lose patent protection with respect to claims of patents listed in the Orange Book related to compounds, methods of treatment, and formulations in the U.S. An additional Orange Book listed patent, which has claims relating to the delivery system, expires in 2025. It is not clear whether this patent will delay approval of PF708.

Our Strategy

Our strategy is to leverage our *Pf*ēnex Expression Technology® protein production platform and our bioanalytical characterization and product development infrastructure to become a leading biotechnology company focused on developing a portfolio of wholly-owned and partnered therapeutics and vaccines.

The key elements to implement our strategy include the following:

- ***Obtain regulatory approval of PF708 and maximize its commercial potential.*** We filed our NDA with the FDA in December 2018 and the FDA accepted the NDA for substantive review in February 2019. We believe we could be in a position for potential commercial launch in the United States as early as the fourth quarter of 2019, subject to FDA approval of the NDA and other factors.
- ***Advance the Jazz partnered programs.*** In July 2016, we entered into an agreement with Jazz Pharmaceuticals, which we amended in December 2017, to collaboratively develop hematology/oncology products, including PF743, a recombinant crisantaspase, and PF745, a recombinant crisantaspase with half-life extension technology.

- ***Develop vaccine programs primarily with non-dilutive government funding and other third-party grants.*** Pursuant to a $145.2 million cost-plus fixed fee advanced development contract with BARDA we are developing Px563L and RPA563 as next generation anthrax vaccine candidates that we believe have the potential to address the limitations of the existing approved anthrax vaccines including compliance, cost and potential fulfillment of the Strategic National Stockpile. The National Institute of Allergy and Infectious Diseases (NIAID) continues to evaluate our vaccine candidate, Px533, against malaria infection. Clinical development of Px533 is controlled and funded by NIAID.
- ***Expand our portfolio of license and supply relationships for our CRM197 vaccine carrier protein.*** We have both licenses and supply agreements in place with vaccine developers for the production and supply of CRM197, which is a non-toxic mutant of diphtheria toxin.
- ***Seek additional product development partnerships.*** We believe that the *Pf*ēnex Expression Technology represents a sustainable competitive advantage in the biopharmaceutical industry and we will seek to further exploit the platform through additional collaborations for products where the platform is uniquely enabling.
- ***Continue to seek collaboration partnerships for our pipeline of biosimilar candidates.*** In addition to our lead product candidates, our pipeline includes various other biosimilar candidates, including PF582, our biosimilar candidate to Lucentis®, and PF529, our biosimilar candidate to Neulasta®.

Our Approach

Our patented protein production platform, *Pf*ēnex Expression Technology®, allows us to address hurdles to development and enable our product candidates and those being developed under collaborations. We believe our technology confers several important competitive advantages compared to traditional techniques for protein production, including the ability to produce complex proteins with higher accuracy and greater degree of protein purity, as well as speed and cost advantages. Our platform utilizes a proprietary high throughput robotically-enabled parallel approach, which allows the construction and testing of thousands of unique protein production variables in parallel, thereby allowing us to produce and characterize complex proteins while reducing the time and cost of development and long-term production.

We have replaced the traditional, trial and error approach to protein production with a simultaneous, parallel processing model that allows the construction and testing of thousands of unique protein production variables in parallel. We believe our platform delivers a significant competitive advantage for protein production, including higher accuracy, greater degree of protein purity, speed and lower costs.

*Pf*ēnex Expression Technology®

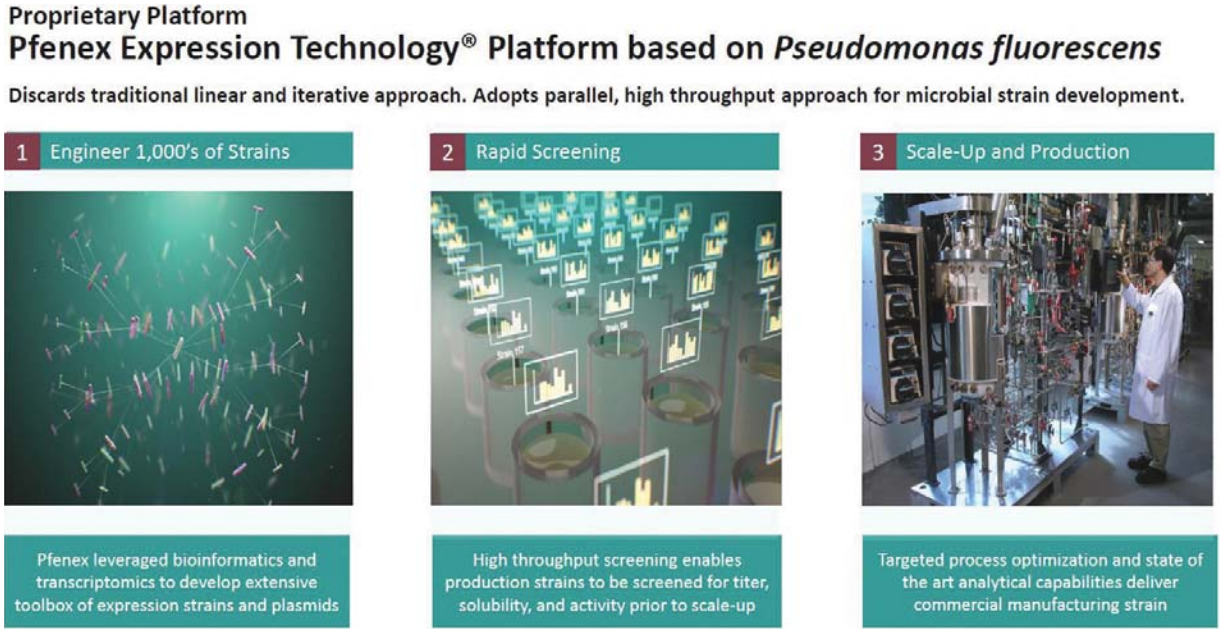
Protein Production Overview

Protein production is a fundamental activity necessary for biological drug development and manufacturing. The most common method of manufacturing therapeutic proteins involves the use of engineered microorganisms. Proteins produced using these organisms are referred to as recombinant proteins. Recombinant proteins are produced by inserting DNA, or a gene, that codes for the protein, into a cell which then acts as a protein production factory. Typically, this is accomplished by inserting DNA into an expression vector, which contains genetic control elements that can be used to turn the gene on and off.

Our platform is based on automated high-throughput screening of large libraries of novel, genetically engineered *P. fluorescens* bacterial expression strains. The libraries contain thousands of expression strains which are constructed from a large inventory of expression vectors, or genetic elements, incorporated into engineered *P. fluorescens* host strains. We then employ automated, robotically enabled parallel high-throughput screening, incorporating extensive bioanalytical testing, in order to select strains from the library which express

the protein of interest at optimal yields, purity and potency. Extensive fermentation scouting experiments on the selected strains allows for the identification of a final production strain with further improvements in the yield of the active therapeutic protein.

Our patented *Pf*ēnex Expression Technology® illustrated in the diagram below utilizes a parallel, high throughput method for microbial strain development compared to the more traditional linear approach of trial and error.



Our *Pf*ēnex Expression Technology® platform consists of three primary elements that, when combined, deliver a significant competitive advantage for protein production that differentiates us in the biopharmaceutical industry.

The three elements include:

- Robust Protein Production Organism
- Creation of Extensive Library of Protein Expression Variants
- Robotically Enabled High Throughput Screening

Robust Protein Production Organism

P. fluorescens has been used industrially where it has efficiently produced complex proteins. We exploit certain attributes of the *P. fluorescens* bacterium that enables us to rapidly identify the optimal strain for a specific protein of interest. The favorable attributes of the *P. fluorescens* bacterium include:

- Secretion of soluble protein into the bacterial periplasm, or the space between the inner and outer membrane in gram negative bacteria, resulting in increased recovery yields of properly folded protein
- *P. fluorescens* genome allows for modifications, including deleting protease genes, or nucleotides that provide instructions for synthesis of RNA into a specific protease, and inserting chaperone and/or disulfide bond isomerase genes, or nucleotides that provide instructions for synthesis of RNA into a specific chaperone or disulfide isomerase, which overall increase the quality and production of properly folded active full length proteins

- Selection of expression strains without the use of antibiotics
- High cell density fermentation due to its obligate aerobe growth nature, or bacterium that can only grow in the presence of oxygen, which improves the protein production for characterization, enables consistent scale-up and long-term low cost of goods

Creation of Extensive Library of Protein Expression Strains

We have developed an extensive toolbox of engineered production strains and expression vectors that can be readily accessed for finding the best choice for manufacturing of a specific protein. This toolbox is continuously growing due to our ongoing research and development efforts. We construct thousands of unique expression strains by combining engineered *P. fluorescens* host strains with proprietary expression vectors. The engineered *P. fluorescens* strains have reduced expression of protein degrading enzymes and/or increased levels of folding elements while the expression vectors consist of plasmids with engineered genetic elements including promoters, ribosome binding sites and secretion leaders. Determining which of these variants will improve production of any particular protein cannot be determined from the amino acid sequence of the protein of interest. As a result, we employ the automated high throughput screening of the engineered production strains in order to select the strain that produces the protein of interest at optimal purity, yield and potency.

Robotically Enabled High Throughput Screening

Our high-throughput automation supports simultaneous, parallel evaluation of thousands of unique protein production alternatives, enabling rapid identification of the optimal production strain for the protein of interest. Our protein production technology employs rapid construction of protein production strains and testing thousands of unique production strains evaluated through automated sample analysis to determine the titer, or quantity of the product per unit volume, of high quality protein each expression strain produces, which can then be analyzed through our high throughput analytical capacity. Our proprietary, robotically enabled automated high throughput screening process, along with our optimized production organism and toolbox of engineered strains and vectors, as well as our expertise in analytical characterization, expedites the development of an optimal protein production engine from approximately one year in a typical case for traditional approaches, if at all possible, to approximately nine weeks with our *Pf*ēnex Expression Technology®.

Our Product Candidates and Collaborations

The development of our own portfolio of product candidates and the candidates we have licensed to collaboration partners has been enabled by our successful history of meeting analytically rigorous client specifications of protein quality, yield and potency using our *Pf*ēnex Expression Technology ®. Our pipeline includes product candidates and preclinical products under development in various stages of development. Details of our pipeline and collaborations are included below.

PF708—Teriparatide

Our lead product candidate, PF708, is a peptide product candidate that is being developed as a therapeutic equivalent to the reference listed drug Forteo, an injectable prescription medicine marketed by Eli Lilly for the treatment of osteoporosis patients at high risk of fractures. Teriparatide is a shortened version of the naturally occurring parathyroid hormone (amino acids 1-34) that promotes bone growth. To date, we have demonstrated production of teriparatide in quantities that we believe predict a competitive cost of goods. Despite Forteo's status as a biologic peptide currently manufactured in *E.coli*, due to its size (less than or equal to 40 amino acids), it is considered a small molecule. As a result, we are developing PF708 pursuant to the Section 505(b)(2) regulatory pathway in the United States. In December 2018, we submitted our NDA for Forteo to the FDA and the FDA accepted the submission for substantive review in February 2019.

Market Overview

The global osteoporosis market represents a significant opportunity, with product sales that are estimated to grow to approximately $6.7 billion in the United States, Japan and the five major European Markets in 2025. According to the National Institutes of Health (NIH), it is estimated that approximately 53 million Americans either have osteoporosis or are at increased risk due to low bone mass (osteopenia). Forteo (marketed as Forsteo in Europe) builds bone primarily by increasing the activity of osteoblasts (cells that deposit bone). Worldwide sales of Forteo were approximately $1.6 billion in 2018, according to Eli Lilly. In addition, TYMLOS® (abaloparatide), marketed by Radius Health, Inc., had U.S. net sales of approximately $0.1 billion in 2018, bringing total osteoporosis product sales to $1.7 billion in 2018. Evenity (romosozumab), a product developed by Amgen Inc. and UCB, is expected to be approved by the FDA in the second half of 2019.

Development

We have performed an extensive bioanalytical comparative analysis of PF708 and Forteo. Based on what we believe to be equivalent results to date, we have not conducted preclinical in vivo studies for safety or efficacy purposes prior to initiating clinical investigation. We have also completed an initial assessment of the PF708 and Forteo injection pens, and we believe that the two injection devices are functionally equivalent. We completed a pharmacokinetic bioequivalence study in healthy subjects in the first half of 2016, and we initiated a comparative immunogenicity/pharmacokinetics study in osteoporosis patients in the fourth quarter of 2016. In November 2017, we announced interim pharmacokinetic (PK) data from the study: the PF708 and Forteo PK profiles are comparable, and there are no statistically significant differences in key PK parameters. In May 2018, we announced positive top-line results from our PF708-301 study, which showed comparable overall profiles between PF708 and Forteo after 24 weeks of daily injection in osteoporosis patients. We submitted an NDA for PF708 to the FDA in December 2018 and the FDA accepted the submission for substantive review in February 2019. We believe that we could be positioned for a potential commercial launch as early as the fourth quarter of 2019 in the U.S., subject to FDA approval and other factors.

Commercialization

Subject to FDA approval and other factors, we anticipate the first commercial sales of PF708 in the US could potentially take place as early as the fourth quarter of 2019. In June 2018, we and Alvogen, through certain of its subsidiaries, entered into US Alvogen Agreement pursuant to which Alvogen received the exclusive right to commercialize and manufacture PF708 in the United States. In February 2019, we and Alvogen, through certain of its subsidiaries, entered into agreements expanding our collaboration to develop and commercialize PF708 to the EU, to certain countries in the Middle East and North Africa (MENA), and the ROW territories (the latter defined as all countries outside of the EU, US and MENA, excluding Mainland China, Hong Kong, Singapore, Malaysia and Thailand). We believe this collaboration leverages Alvogen's established international experience and expertise in regulatory, IP and supply chain activities, as well as its established network of specialty marketing and sales pharmaceutical companies in these regions. Subject to applicable regulatory approvals, PF708 will be commercialized in Europe and Switzerland by Theramex, a leading global specialty pharmaceutical company dedicated to Women's Health, in MENA by SAJA, a Tamer Group company, and in ROW by Alvogen's current and/or future commercialization partners. Under the terms of the agreements, Alvogen will be responsible for the local activities through Theramex, SAJA and its other commercialization partners and for overseeing any clinical development, regulatory, litigation, commercial manufacturing and commercialization.

Px563L and RPA563

Px563L and RPA563 are novel anthrax vaccine candidates based on a recombinant modified form (mutant) of the protective antigen from *Bacillus anthracis* (anthrax). We are developing Px563L and RPA563 in response to the United States government's unmet demand for increased quantity, stability and dose sparing regimens of

anthrax vaccine. We believe that Px563L and RPA563 can address each of these demands. We initiated a randomized, placebo-controlled Phase 1a trial in healthy subjects in the second half of 2015 to investigate the safety and immunogenicity of Px563L and RPA563, and we announced the results from an interim analysis in the second half of 2016. Findings indicated that the vaccine was well-tolerated, with the potential to afford immunogenicity protection against anthrax infection after only two injections (vs. three for the currently licensed anthrax vaccine product). The development of Px563L and RPA563 are funded by the U.S. Department of Health and Human Services (HHS) through BARDA under a contract providing up to $145.2 million in funding. Subject to continued funding from BARDA, we expect to continue to advance the program with the potential to prepare for a Phase 2 trial start in late 2019.

Market Overview

In October 2001, letters contaminated with anthrax spores were delivered to government officials and members of the media in the United States. As a result of these attacks, 22 people became infected with anthrax and five people died. In response to this and other terrorist attacks around the world, the biodefense market has grown dramatically. In December 2016, the Centers for Disease Control (CDC) signed a procurement contract for BioThrax valued at up to $911 million to supply to the Strategic National Stockpile that represents approximately 29.4 million doses through September 2021. The federal government spends billions of dollars in biodefense through HHS, CDC, NIAID and Office of Public Health Preparedness and Response. In 2013, the Pandemic and All-Hazards Preparedness Reauthorization Act (PAHPRA), which was originally passed in 2006 to improve the United States' public health and medical preparedness and response capabilities for emergencies, authorized $2.8 billion for the procurement of countermeasures for biological, chemical, radiological and nuclear attacks. If successful with clinical development, we believe we may be able to enter into a procurement relationship with the US federal government to supply a next generation recombinant protective antigen (rPA) based anthrax vaccine to the Strategic National Stockpile.

Development

In preclinical animal studies, Px563L has resulted in a greater immune response than the only available anthrax vaccine, BioThrax, and has the potential to provide longer protective immunity with fewer vaccinations. Through the application of our *Pf*ēnex Expression Technology® we have developed a robust production strain for manufacturing that has demonstrated an ability to produce large amounts of mutant recombinant protective antigen (mrPA).

In August 2016, we announced positive immunogenicity and safety data from Day 70 analysis of the Px563L anthrax vaccine study. The randomized, double-blind, placebo-controlled Phase 1a study enrolled three cohorts in a dose-escalating manner (10 mcg, 50 mcg and 80 mcg of antigen). Within each cohort, subjects received Px563L, RPA563 or placebo in an 8:8:2 ratio. Subjects were administered two doses of vaccine or placebo 28 days apart. Interim results indicated that the vaccine was well-tolerated, with the potential to afford immunogenicity protection against anthrax infection after only two injections (vs. three for the currently licensed anthrax vaccine product). Immunogenicity was assessed by toxin-neutralizing antibody (TNA) expressed as 50% neutralizing factor (NF50), with a threshold value ≥ 0.56 correlating with significant survival in animal models of anthrax infection. On Day 70, 100% of Px563L subjects at the 10 mcg and 80 mcg dose levels achieved a TNA $NF_{50} \geq 0.56$, and 87.5% at the 50 mcg dose level achieved the target threshold. An additional success criterion for assessing anthrax vaccine immunogenicity is for the lower confidence limit (LCL), or the lower bound of 95% confidence interval, of the percentage of subjects who met or exceeded the TNA NF_{50} threshold of 0.56, to be greater than or equal to 40%. On Day 70, all doses of Px563L exceeded this threshold, which was established by the currently licensed anthrax vaccine for the indication of post-exposure prophylaxis.

We announced positive interim results from a Phase 1a study in healthy subjects in the second half of 2016, and in January 2017, BARDA exercised two options under its existing contract, allowing for the continued development of Px563L and RPA563. Over the course of 2018, we continued to collect favorable stability data

for both products and also completed feasibility studies that demonstrated the compatibility of both products with the USP compendial relative potency method for anthrax. In addition, we completed adjuvant manufacturing optimization and bulk drug substance manufacturing process establishment runs at the commercial contract manufacturer. In October 2017, we completed a meeting with the FDA in which the FDA provided guidance for the proposed clinical development and licensure plans for post-exposure prophylaxis indication. In 2018 we completed non-clinical animal studies and related analytical work. In December of 2018, we conducted a Type C meeting with the US FDA to discuss the preliminary studies completed with a potency method adapted from the USP relative potency method for anthrax vaccine adsorbed (AVA). The FDA response was that the data generated from the preliminary studies in guinea pig are encouraging and offered to review protocols and statistical approach for both qualification and validation of the method going forward. In January of 2019 we held an In Process Review (IPR) meeting with the Public Health Emergency Medical Countermeasures Enterprise (PHEMCE) Milestone Decision Authority (MDA). Potential next milestones are the triggering of analytical and non-clinical animal study options, leading to a potential Phase 1b/2 study in 2019, subject in each case to continued funding by BARDA.

Multiple early stage hematology/oncology product candidates in collaboration with Jazz Pharmaceuticals

We are collaboratively developing certain hematology/oncology products with Jazz. The programs are advancing according to mutually agreed development plans. In the third quarter of 2017, we completed a process development milestone associated with this collaboration. In December 2017, we signed an amended and restated agreement under which we will be eligible to receive an additional $43.5 million in amendment fee and development milestone payments as compared to the 2016 agreement, increasing the total value of upfront, option and amendment fee payments and potential payments for the achievement of development, regulatory and sales-related milestones associated with the collaboration to an aggregate of $224.5 million. We will also continue to be eligible to receive tiered royalties on worldwide sales of any products resulting from the collaboration at rates reduced from those under the 2016 agreement.

Pipeline Products

Our pipeline includes biosimilar candidates to certain reference products, including biosimilar candidates to Lucentis® and Neulasta®. Following our strategic review in November 2017, we decided to pause development activities on PF582, our biosimilar candidate to Lucentis® and PF529, our biosimilar to Neulasta® and focus development efforts elsewhere within the product portfolio while we continue to engage potential strategic partners to advance the program and maximize value.

Collaborations, Joint Development and Licenses

PF708 & Jazz Pharmaceuticals

For a discussion of our collaborations relating to PF708 and our collaborations relating to Jazz Pharmaceuticals, please see "*Business—Our Product Candidates and Collaborations—PF708—Teriparatide" and "Business—Our Product Candidates and Collaborations—Multiple early state hematology/oncology product candidates in collaboration with Jazz Pharmaceuticals*," respectively.

Pfizer

In February 2015, we entered into a development and license agreement with Pfizer to develop and commercialize PF582. In August 2016, we entered into a termination agreement with Pfizer pursuant to which the development and license agreement was terminated and all rights to PF582 have been returned to us. The termination accelerated recognition of $45.8 million of revenue that had been previously deferred and we will not recognize any additional future revenue under the Pfizer development and license agreement. Following our strategic review in November 2017, we decided to pause our development activities for PF582 and focus our

efforts and resources elsewhere in our product portfolio. While we are seeking a new collaboration partner for the -development and commercialization of PF582, there are no assurances that we will find a new collaboration partner or that the terms and timing of any such arrangements would be acceptable to us.

The Dow Chemical Company

On November 30, 2009, we entered into a series of agreements with Dow Global Technologies LLC and/or The Dow Chemical Company, or collectively, Dow, including a technology assignment agreement, a technology licensing agreement, and a grant-back and technology license agreement. Under the technology assignment agreement, Dow assigned to us certain patents, know-how and trademarks relating to our *Pf*ēnex Expression Technology®. Under the technology licensing agreement, Dow granted us exclusive licenses to exploit certain patents relating to RNA viruses and oral immunization methods (each of which were subsequently terminated), and certain amended recombinant cells, and a non-exclusive license to exploit certain patents relating to production and isolation techniques for peptides and proteins made using our *Pf*ēnex Expression Technology®. Under the grant-back and technology license agreement, we granted to Dow exclusive and non-exclusive licenses under certain patents and know-how relating to our *Pf*ēnex Expression Technology® to use certain biological materials to make, use and commercialize products in certain fields of use that do not include human therapeutics.

The U.S. Department of Health and Human Services

For a discussion of our collaborations relating to the U.S. Department of Health and Human Services, please see *"Business—Our Product Candidates and Collaborations—Px563L and RPA563."*

The National Institute of Allergy and Infectious Diseases (NIAID)

In September 2012, we entered into a contract with NIAID for the development of a next generation anthrax vaccine. Under the contract, which was amended in April 2013 and November 2013, we agreed to provide services to NIAID for approximately 25 months under a cost-plus fixed fee contract with a total value of approximately $2.2 million. In addition to the base period, NIAID had 13 options to extend the term of the contract, with payments totaling approximately $22.9 million. NIAID exercised an option effective January 2015 and another effective May 2016. The contract was extended through the end of December 31, 2017, when the development contract was completed in accordance with its terms.

Customers

As of December 31, 2018, we had generated only limited revenue from government contracts, service agreements, collaboration agreements, and reagent protein product sales. Our total revenue was $14.9 million, $28.8 million and $60.2 million in 2018, 2017 and 2016, respectively. In 2018 and 2017, our revenue was primarily derived from our collaboration agreement with Jazz and from our advanced development contract with BARDA. Our achievement of certain development milestones related to the Jazz agreement resulted in significant additional revenue in 2017. In 2016, a significant portion of our revenue was derived from recognizing $45.8 million in revenue upon termination of the Pfizer agreement in August 2016, in addition to revenue derived from development and license agreements.

For the years ended December 31, 2018 and 2017, Jazz and BARDA each accounted for more than 10% of our revenue. For the year ended December 31, 2016, Pfizer accounted for more than 10% of our revenue.

Government Regulation

Government authorities in the United States, at the federal, state and local level, and in the European Economic Area, at the European Union and national Member State level, extensively regulate, among other

things, the research, development, testing, manufacturing, labeling, packaging, promotion, advertising, storage, distribution, marketing, post-approval monitoring and reporting, and export and import of drugs and biologics such as those we are developing. We, along with third-party contractors, will be required to navigate the various preclinical, clinical and commercial approval requirements of the governing regulatory agencies of the countries in which we wish to conduct studies or seek approval or licensure of our product candidates. The process of obtaining regulatory approvals and the subsequent compliance with appropriate federal, state, local, and foreign statutes and regulations require the expenditure of substantial time and financial resources.

United States Government Regulation

BLA/NDA Development and Approval Process

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

- completion of preclinical laboratory tests and animal studies performed in accordance with the FDA's current Good Laboratory Practice, or GLP, regulations;
- submission to the FDA of an investigational new drug, or IND, application which must become effective before human clinical trials may begin and must be updated annually;
- approval by an independent institutional review board, or IRB, or ethics committee at each clinical site before the trial is initiated;
- performance of adequate and well-controlled clinical trials to establish the safety and efficacy of the proposed drug for each indication;
- preparation of and submission to the FDA of a BLA or NDA after successful completion of all pivotal clinical trials;
- satisfactory completion of an FDA Advisory Committee review, if applicable;
- a determination by the FDA within 60 days of its receipt of an NDA or BLA to file the application for substantive review;
- satisfactory completion of an FDA pre-approval inspection of the manufacturing facility or facilities at which the proposed product is produced to assess compliance with cGMP and to assure that the facilities, methods and controls are adequate to preserve the biological product's continued safety, purity and potency; and
- FDA review and approval of the BLA or NDA prior to any commercial marketing or sale of the biologic product in the United States.

The preclinical and clinical testing and approval process requires substantial time, effort, and financial resources, and we cannot be certain that any approvals for our product candidates will be granted on a timely basis, if at all. An IND is a request for authorization from the FDA to administer an investigational new drug product to humans. The central focus of an IND submission is on the general investigational plan and the protocol(s) for human studies. The IND also includes results of animal and in vitro studies assessing the toxicology, pharmacokinetics, pharmacology, and pharmacodynamic characteristics of the product; chemistry, manufacturing, and controls information; and any available human data or literature to support the use of the investigational product. An IND must become effective before human clinical trials may begin. An IND will automatically become effective 30 days after receipt by the FDA, unless before that time the FDA raises concerns or questions related to the proposed clinical studies. In such a case, the IND may be placed on clinical hold and the IND sponsor and the FDA must resolve any outstanding concerns or questions before clinical studies can begin. Accordingly, submission of an IND may or may not result in the FDA allowing clinical studies to commence.

Clinical trials involve the administration of the investigational product to human subjects under the supervision of qualified investigators in accordance with current Good Clinical Practices (cGCPs), which include the requirement that all research subjects provide their informed consent for their participation in any clinical study. Clinical trials are conducted under protocols detailing, among other things, the objectives of the study, the parameters to be used in monitoring safety and the effectiveness criteria to be evaluated. Each clinical protocol and any subsequent protocol amendments must be submitted to the FDA as part of the IND, and an IRB for each site where the study is conducted must also approve the study. The IRB must monitor the study until completed. There are also requirements governing the registration of ongoing clinical studies and the reporting of clinical study results to public registries. Clinical trials typically are conducted in three or four sequential phases, but the phases may overlap or be combined.

- Phase 1. The investigational product is initially introduced into healthy human subjects or patients with the target disease or condition. These studies are designed to evaluate the safety, dosage tolerance, metabolism and pharmacologic actions of the investigational product in humans, the side effects associated with increasing doses, and, if possible, to gain early evidence on effectiveness.
- Phase 2. The investigational product is administered to a limited patient population to evaluate dosage tolerance and optimal dosage, identify possible adverse side effects and safety risks, and preliminarily evaluate efficacy.
- Phase 3. The investigational product is administered to an expanded patient population, generally at geographically dispersed clinical study sites, to generate enough data to evaluate, in a statistically rigorous manner, dosage, clinical effectiveness and safety, to establish the overall benefit-risk relationship of the investigational product, and to provide an adequate basis for product labeling and approval.
- Phase 4. In some cases, the FDA may condition approval of an NDA or BLA for a product candidate on the sponsor's agreement to conduct additional clinical studies after approval. In other cases, a sponsor may voluntarily conduct additional clinical studies after approval to gain more information about the product. Such post-approval studies are typically referred to as Phase 4 clinical trials.

A pivotal trial is a clinical study that is designed to generate substantial evidence of a product's safety and efficacy that adequately meets regulatory agency requirements to justify the approval of the product. Generally, pivotal trials are Phase 3 trials, but the FDA may accept results from Phase 2 trials if the trial design provides a well-controlled and reliable assessment of clinical benefit, particularly in situations where there is an unmet medical need and the results are sufficiently robust.

Phase 1, Phase 2 and Phase 3 trials may not be completed successfully within a specified period, if at all, and there can be no assurance that the data collected will support FDA approval or licensure of the product. Furthermore, the FDA, the IRB, or the clinical study sponsor may suspend or terminate a clinical study at any time on various grounds, including a finding that the research subjects are being exposed to an unacceptable health risk. Additionally, some clinical studies are overseen by an independent group of qualified experts organized by the clinical study sponsor, known as a data safety monitoring board or data monitoring committee. Such a group recommends to the sponsor whether or not a trial should move forward at designated check points based on access to certain data from the trial. A sponsor may also suspend or terminate a clinical study based on evolving business objectives and/or competitive climate.

Assuming successful completion of all required testing in accordance with all applicable regulatory requirements, detailed information regarding the investigational product is submitted to the FDA in the form of an NDA or BLA requesting approval to market the product for one or more indications. The NDA or BLA must include all relevant data available from pertinent preclinical and clinical trials, including negative or ambiguous results as well as positive findings, together with detailed information relating to the product's chemistry, manufacturing, controls, and proposed labeling, among other things. Data can come from company-sponsored clinical studies intended to test the safety and effectiveness of a use of the product, or from a number of

alternative sources, including studies initiated by investigators. Under federal law, the submission of most NDAs and BLAs is subject to an application user fee, and the sponsor of an approved NDA or BLA is also subject to annual program fees. These fees are typically increased annually. A waiver of user fees may be obtained under certain limited circumstances.

Once an NDA or BLA has been submitted, the FDA's goal is to review the application within ten months after it accepts the application for filing, or, if the application has been granted priority review because the proposed drug addresses an unmet medical need in a serious or life-threatening indication, six months after the FDA accepts the application for filing. The review process is often extended by FDA requests for additional information or clarification. Generally, the FDA reviews an NDA or BLA to determine, among other things, whether the proposed product is safe and effective for its intended use, and whether the product is being manufactured in accordance with cGMP to assure and preserve the product's quality and purity.

Before approving a BLA or NDA, the FDA typically will inspect the facility or facilities at which the product is manufactured. The FDA will not approve the application unless it determines that the manufacturing processes and facilities are in compliance with cGMP requirements and adequate to assure consistent production of the product within required specifications. Additionally, before approving a BLA or NDA, the FDA will typically inspect one or more clinical sites to assure compliance with cGCP. If the FDA determines that the application, clinical data, manufacturing process or manufacturing facilities are not acceptable, it will outline the deficiencies in the submission and often will request additional testing or information. Notwithstanding the submission of any requested additional information, the FDA ultimately may decide that the application does not satisfy the regulatory criteria for approval.

The FDA is required to refer an application for a product with active ingredients that have not been previously approved to an advisory committee or explain why such referral was not made. The FDA also can seek advice from an advisory committee at its own discretion when an NDA or BLA presents scientific, technical, or policy questions on which the agency believes it would benefit from the perspectives of outside experts. Typically, an advisory committee is a panel of independent experts, including clinicians and other scientific experts, that reviews, evaluates and provides a recommendation as to whether the application should be approved and under what conditions. The FDA is not bound by the recommendations of an advisory committee, but it considers such recommendations carefully when making decisions.

The development, testing and approval process requires substantial time, effort and financial resources, and each may take several years to complete. The FDA may not grant approval on a timely basis, or at all, and we and our partners may encounter difficulties or unanticipated costs in our efforts to secure necessary governmental approvals, which could delay or preclude us from marketing our products. After the FDA evaluates a BLA or NDA and conducts inspections of manufacturing facilities where the investigational product and/or its drug substance will be produced, the FDA may issue an approval letter or a Complete Response Letter. An approval letter authorizes commercial marketing of the product under the conditions of use described in the product's prescribing information. A Complete Response Letter indicates that the review cycle of the application is complete and the application is not ready for approval. A Complete Response Letter may require additional clinical data, an additional pivotal Phase 3 trial or trials, and/or other significant, expensive and time-consuming requirements related to clinical trials, preclinical trials or manufacturing. Even if such additional information is submitted, the FDA may ultimately decide that the BLA or NDA does not satisfy the criteria for approval. The FDA may also approve the BLA or NDA with a Risk Evaluation and Mitigation Strategy, or REMS, to mitigate risks, which could include medication guides, physician communication plans, or elements to assure safe use, such as restricted distribution methods, patient registries and other risk minimization tools. The FDA also may condition approval on, among other things, changes to proposed labeling, development of adequate controls and specifications, or a commitment to conduct one or more post-market studies or clinical trials. Such post-market testing may include Phase 4 trials and surveillance to further assess and monitor the product's safety and effectiveness after commercialization. New government requirements, including those resulting from new legislation, may be established, or the FDA's policies may change, which could delay or prevent regulatory approval.

Drugs and biologics manufactured or distributed pursuant to FDA approvals are subject to extensive and continuing regulation by the FDA, including, among other things, requirements relating to recordkeeping, periodic reporting, product sampling and distribution, advertising and promotion and reporting of adverse experiences with the product. After approval, many changes to the approved product, such as adding new indications or other labeling claims, are subject to prior FDA review and approval. There also are continuing, annual user fee requirements for marketed products. Manufacturers are subject to periodic unannounced inspections by the FDA and state agencies for compliance with cGMP requirements. Changes to the manufacturing process are strictly regulated, and, depending on the significance of the change, may require prior FDA approval before being implemented. FDA regulations also require investigation and correction of any deviations from cGMP and impose reporting and documentation requirements upon us and any third-party manufacturers that we may decide to use. Accordingly, manufacturers must continue to expend time, money and effort in the area of production and quality control to maintain compliance with cGMP and other aspects of regulatory compliance.

We rely, and expect to continue to rely, on third parties for the production of clinical quantities of our product candidates, and expect to rely in the future on third parties for the production of commercial quantities. Future FDA and state inspections may identify compliance issues at our facilities or at the facilities of our contract manufacturers that may disrupt production or distribution, or require substantial resources to correct. In addition, discovery of previously unknown problems with a product or the failure to comply with applicable requirements may result in restrictions on a product, manufacturer or holder of an approved NDA or BLA, including withdrawal or recall of the product from the market or other voluntary, FDA-initiated or judicial action that could delay or prohibit further marketing. The FDA strictly regulates marketing, labeling, advertising, and promotion of products that are placed on the market. Drugs and biologics may be promoted only for the approved indications and in accordance with the provisions of the approved label. The FDA and other agencies enforce the laws and regulations prohibiting the promotion of unapproved uses, and a company that is found to have improperly promoted unapproved uses may be subject to significant enforcement action and liability.

The FDA may withdraw or suspend approval if compliance with regulatory requirements and standards is not maintained or if problems occur after the product reaches the market. Later discovery of previously unknown problems with a product, including adverse events of unanticipated severity or frequency, or with manufacturing processes, or failure to comply with regulatory requirements, may result in a variety of consequences, including revisions to the approved labeling to add new safety information, imposition of post-market studies or clinical studies to assess new safety risks, or imposition of distribution restrictions or other restrictions under a REMS program. Other potential consequences include, among other things:

- restrictions on the marketing or manufacturing of the product, complete withdrawal of the product from the market or product recalls;
- adverse publicity, fines, untitled or warning letters or holds on post-approval clinical trials;
- refusal of the FDA to approve pending applications or supplements to approved applications;
- product seizure or detention, or refusal to permit the import or export of products; or
- injunctions or the imposition of civil or criminal penalties.

505(b)(2) New Drug Applications

Under the Hatch-Waxman Act, a pharmaceutical manufacturer may file an abbreviated new drug application, or ANDA, seeking approval of a generic copy of an approved branded product by demonstrating the proposed generic product's sameness to the approved drug. Additionally, a pharmaceutical manufacturer may, under Section 505(b)(2) of the Federal Food, Drug, and Cosmetic Act (FFDCA), file a new drug application (NDA) that relies on studies not conducted by the applicant and for which the applicant has not obtained a right of reference as part of the data demonstrating the product's safety and effectiveness. Often, this is done by

relying on FDA's previous approval of a product to which the proposed drug is similar (but for which there are differences that preclude an ANDA). Among other things, this kind of reliance avoids unnecessary duplication of studies performed on a previously approved ("reference" or "listed") drug that can reasonably be extrapolated to the proposed product. We are pursuing a Section 505(b)(2) regulatory strategy for our PF708 product candidate; the NDA we have submitted references Forteo (teriparatide), which is marketed by Eli Lilly for the treatment of osteoporosis, as a listed drug.

An NDA sponsor must list with the FDA patents that claim the subject product (the drug substance or product formulation) or an FDA-approved method of using the product. Those patents are published in the Orange Book with the product listing. A 505(b)(2) NDA referencing a listed drug must contain one of the following certifications regarding each of the patents listed in the Orange Book with the referenced product: (1) that no such patent information has been listed in the Orange Book, referred to as a Paragraph I Certification; (2) that such patent has expired, referred to as a Paragraph II Certification; (3) the date on which such patent expires, referred to as a Paragraph III Certification; or (4) that such patent is invalid or will not be infringed by the manufacture, use or sale of the drug product for which the application is submitted, referred to as a Paragraph IV Certification. With regard to patents that claim a method of use, the applicant may instead submit a "section viii" statement certifying that the proposed labeling does not contain any language regarding the patented method of use; this typically reflects the sponsor having "carved out" any such labeling. A Paragraph III Certification conveys that the applicant will wait to obtain approval until the subject patent expires. A Paragraph IV Certification is a challenge to the ability of the subject patent to prevent approval of the proposed product. An applicant making a Paragraph IV Certification must provide notice of the patent challenge to the owner of the subject patent and to the reference product sponsor. If, with 45 days of the Paragraph IV notice, either of those entities files a lawsuit alleging patent infringement, the FDA is prohibited from approving the 505(b)(2) NDA for 30 months (or a shorter period if the patent expires or there are certain settlements or judicial decisions in the patent litigation).

Additionally, a 505(b)(2) NDA will not be approved until any applicable non-patent exclusivity listed in the Orange Book for the referenced drug has expired. These exclusivities include new chemical entity, or NCE, exclusivity, which is awarded to a product that contains an active moiety that has not previously been approved by the FDA. An "active moiety" is the molecule or ion responsible for the drug substance's physiological or pharmacologic action. NCE exclusivity provides a five-year period during which the FDA cannot accept for filing any ANDA or 505(b)(2) NDA for a product containing the same active moiety. The five-year period is shortened to four years if the proposed application contains a Paragraph IV Certification. A drug may obtain a three-year period of exclusivity for a particular condition of approval, or change to a marketed product, such as a new formulation for a previously approved product, if one or more new clinical trials, other than bioavailability or bioequivalence studies, was essential to the approval of the application and was conducted or sponsored by the applicant. This exclusivity precludes the FDA granting final approval to any ANDA or 505(b)(2) NDA that references the product until three years after the product was approved. Unlike NCE exclusivity, however, three-year exclusivity does not prevent the FDA accepting and reviewing the ANDA or 505(b)(2) NDA.

Patent Term Restoration

Depending upon the timing, duration, and specifics of the FDA approval of our product candidates, the term of some of our U.S. patents may be eligible for limited extension under the Hatch-Waxman Act. For a product that represents the first permitted commercial marketing of an active ingredient, we may have the opportunity to extend the term of a patent that claims the drug or a method of using or manufacturing the drug. The extension cannot exceed five years or extend the patent term beyond fourteen years after approval, but it is calculated generally as half the time between the effective date of an IND and the submission date of the NDA or Biologics License Application, or BLA, plus the time between the submission date and approval of the application. Only one patent applicable to an approved product is eligible for the extension and the application for the extension must be submitted prior to the expiration of the patent. The U.S. Patent and Trademark Office, in consultation with the FDA, reviews and approves the application for any patent term extension or restoration. In the future, we

may apply for restoration of patent term for one of our currently owned or licensed patents to add patent life beyond its current expiration date, depending on the expected length of the clinical studies and other factors involved in the filing of the relevant NDA or BLA.

Abbreviated Licensure Pathway of Biological Products as Biosimilar or Interchangeable

The Biologics Price Competition and Innovation Act of 2009, or BPCIA, amended the PHSA and created an abbreviated approval pathway for biological products shown to be highly similar to an FDA-licensed reference biological product. Such a product, known as a "biosimilar," is a biological product that is highly similar to a previously approved biological (the "reference product"), notwithstanding minor differences in clinically inactive components, and for which there are no clinically meaningful differences in safety, purity, and potency between the biosimilar and the reference product. The abbreviated approval pathway is intended to allow the biosimilar to be approved in part in reliance on what is known about the reference product. In addition, if certain additional conditions are shown, a biosimilar product can be designated as "interchangeable" with the reference product, meaning that the biosimilar may be substituted for the reference product without the intervention of the health care provider who prescribed the reference product. To date, the FDA has not approved any biosimilar product as being interchangeable to the reference product. FDA approval is required before a biosimilar may be marketed in the United States. Because of complexities associated with the large and intricate structures of biological products and the processes by which such products are manufactured, FDA has discretion over the kind and amount of scientific evidence—including laboratory, preclinical and/or clinical data—required to demonstrate biosimilarity to a licensed biological product. The FDA considers the totality of the evidence provided by a sponsor to support a demonstration of biosimilarity, and recommends that sponsors use a stepwise approach in the development of their biosimilar products.

The timing of final FDA approval of a biosimilar for commercial distribution depends on a variety of factors, including whether the manufacturer of the reference product is entitled to one or more statutory exclusivity periods, during which time the FDA is prohibited from approving any products that are biosimilar to the reference product. The FDA cannot approve a biosimilar application for twelve years from the date of first licensure of the reference product. Additionally, a biosimilar product sponsor may not submit an application for four years from the date of first licensure of the reference product. A reference product may also be entitled to other types of exclusivities, such as orphan drug exclusivity (which provides seven years of exclusivity against approval of the same drug intended to treat the same disease or condition) or pediatric exclusivity (which adds six months to existing exclusivities, among other things). The first biosimilar product determined to be interchangeable with a reference product for any condition of use is also entitled to a period of exclusivity, during which time the FDA may not determine that another product is interchangeable with the reference product for any condition of use.

In addition, the BPCIA includes a detailed framework for addressing potential patent disputes between the sponsors of a biosimilar product and the reference product.

While it may be possible for a biosimilar applicant and reference product sponsor to settle any patent disputes prior to approval, patent litigation may delay the ability of a biosimilar applicant to commercially launch its product.

We anticipate that the contours of the BPCIA will continue to be defined as the statute is implemented over a period of years. This likely will be accomplished by a variety of means, including decisions related to the statute by relevant federal courts, FDA issuance of guidance documents, and FDA decisions in the course of considering specific applications.

The Animal Rule

In the case of product candidates that are intended to treat or prevent certain serious or life-threatening conditions caused by exposure to lethal or permanently disabling toxic agents, such as our anthrax vaccine

product candidates, conducting controlled clinical trials to determine efficacy may be unethical or unfeasible. Under FDA regulations often referred to as the "Animal Rule" and agency guidance, efficacy for such products can under certain circumstances be demonstrated based on adequate and well-controlled animal studies, provided that certain criteria are met such that it is reasonable to expect the effectiveness of the drug in animals to be a reliable indicator of its effectiveness in humans. Because the FDA must agree that data derived from animal studies establish that the product is reasonably likely to produce clinical benefit in humans, seeking approval under the Animal Rule may add significant time, complexity and uncertainty to the development, testing, and approval process. In addition, products approved under the Animal Rule are subject to additional requirements including post-marketing study requirements, restrictions to ensure safe use (if needed), and labeling requirements to inform patients that the drug's approval was based on efficacy studies conducted in animals alone.

European Economic Area Regulation

In the European Economic Area, or EEA, comprising the European Community (European Union) plus Iceland, Liechtenstein and Norway, the information that must be submitted to the European Medicines Agency, or EMA, or to the competent authorities in the relevant European Union Member States varies depending on whether the biological medicinal product is a new product, whose quality, safety and efficacy has not previously been demonstrated in humans or a product whose known biological active substance and certain other properties are similar to those of a previously authorized (reference) biological medicinal product. The European Directive 2001/83/EC as amended defines a medicinal product as any substance or combination of substances:

- presented as having properties for treating or preventing disease in human beings; or
- which may be used in or administered to human beings either with a view to restoring, correcting or modifying physiological functions by exerting a pharmacological, immunological or metabolic action, or to making a medical diagnosis.

Directive 2001/83/EC as amended further defines the category of biological medicinal products as:

- a product, the active substance of which is a biological substance. A biological substance is a substance that is produced by or extracted from a biological source and that needs for its characterization and the determination of its quality a combination of physico-chemical-biological testing, together with the production process and its control.

Examples of biological medicinal products include recombinant proteins, monoclonal antibodies, vaccines, and products derived from human blood or plasma.

Approval of New Biological Medicinal Products

In the EEA, all medicinal products (biological or not) can only be commercialized after obtaining a Marketing Authorization, or MA. There are two types of MA:

The Community MA, which is issued by the European Commission through the Centralized Procedure, based on the opinion of the CHMP of the EMA, is valid throughout the entire territory of the EEA. The Centralized Procedure is mandatory for certain types of products, such as medicinal products derived from certain biotechnology processes (including biotechnology-derived proteins such as the ones we make), orphan medicinal products, and medicinal products containing a new active substance indicated for the treatment of AIDS, cancer, neurodegenerative disorders, diabetes and auto-immune and viral diseases. The Centralized Procedure is optional for products containing a new active substance not yet authorized in the EEA, or for products that constitute a significant therapeutic, scientific or technical innovation or which are in the interest of public health in the European Union.

National MAs, which are issued by the competent authorities of the Member States of the EEA and only cover their respective territory, are available for products not falling within the mandatory scope of the

Centralized Procedure. Where a product has already been authorized for marketing in a Member State of the EEA, this National MA can be recognized in other Member States through the Mutual Recognition Procedure. If the product has not received a National MA in any Member State at the time of application, it can be approved simultaneously in various Member States through the Decentralized Procedure.

Under the above described procedures, before granting the MA, the EMA or the competent authorities of the Member States of the EEA make an assessment of the risk-benefit balance of the product on the basis of scientific criteria concerning its quality, safety and efficacy.

More concretely, the requirements for centralized marketing authorization of a new biological medicinal product in the EEA generally include but are not limited to:

- submission of the results of pharmaceutical (physico-chemical, biological or microbiological) tests and preclinical (toxicological and pharmacological) tests through laboratory tests and animal studies in compliance with Good Laboratory Practice, or GLP;
- submission of the results of adequate and well-controlled clinical trials to establish the quality, safety and efficacy of the product for each indication;
- a statement to the effect that clinical trials carried outside the European Union meet the ethical requirements of Directive 2001/20/EC;
- submission of an application for marketing authorization to the EMA or to the competent authorities of the relevant EU Member States;
- establishment of the applicant in the EEA;
- description of the qualitative and quantitative particulars of all constituents of the medicinal product;
- evaluation of the potential environmental risks posed by the medicinal product;
- description of the manufacturing method, description of the control measures employed by the manufacturer, and a document showing that the manufacturer is authorized in his own country to produce medicinal products;
- a summary of product characteristics, therapeutic indications, adverse reactions, dosage, pharmaceutical form, route of administration and expected shelf life;
- additional information for specific classes of medicinal products, such as a Vaccine Antigen Master File documentation for vaccine products;
- a summary of the pharmacovigilance system, the risk management plan describing the risk-management system, and proof that the applicant has the services of a qualified person responsible for pharmacovigilance as well as the necessary means for fulfilling the EU pharmacovigilance obligations including the notification of any adverse reaction suspected of occurring either in the EEA or in a third country; and
- review by EMA's CHMP or the competent authorities in the relevant European Union Member States and approval of the marketing authorization application.

Preclinical tests include laboratory evaluations of the product's structure, purity and biological activity, as well as animal studies to determine toxicity and pharmacology. An Investigational Medicinal Product (IMP) sponsor must submit a Clinical Trial Application (CTA) to the competent authority prior to initiation of human clinical trials. The application process to perform a clinical trial in the EEA is governed on a country-by-country basis. A sponsor must apply in each country in which it intends to conduct any part of a human clinical trial. While the process is similar in most countries, additional materials may be required in certain instances. For example, in many, but not all European countries, a sponsor must submit a copy of the insurance coverage obtained to cover the clinical study. Australia and New Zealand adhere to EMA guidelines with respect to the regulation of IMPs and clinical trials.

Assuming successful completion of the required clinical testing, and having met all criteria set forth by Directive 2001/83/EC and Regulation (EC) No 726/2004, the applicant may choose to proceed with submission of marketing authorization application. If the application is accepted for review in the Centralized Procedure, within 210 days (excluding clock stops), the EMA's CHMP will issue an opinion on whether the conditions for granting marketing authorization are satisfied. During the review period, the scientific committees will review the scientific data, may request for independent testing of the medicinal product, its starting materials, or other constituent materials, may request supplemental information from the applicant, may request for proof of cGMP compliance of the manufacturer, and may request for said manufacturing facilities to be inspected.

Accelerated Review

Under the Centralized Procedure in the European Union, the maximum timeframe for the evaluation of a marketing authorization application is 210 days (excluding clock stops, when additional written or oral information is to be provided by the applicant in response to questions asked by the EMA's CHMP). Accelerated evaluation might be granted by the CHMP in exceptional cases, when a medicinal product is expected to be of a major public health interest, particularly from the point of view of therapeutic innovation. In this circumstance, EMA ensures that the opinion of the CHMP is given within 150 days, excluding clock stops.

Approval of Similar Biological Medicinal Products

Similar biological medicinal product applications of medicinal products authorized via the Centralized Procedure have automatic access to the Centralized Procedure. A similar biological medicinal product, also known as a biosimilar, is a product that is similar to a biological medicine that has already been authorized, the so-called "reference medicinal product". The active substance of a similar biological medicinal product is a known biological active substance and similar to the one of the reference medicinal product. A similar biological medicinal product and its reference medicinal product are expected to have the same safety and efficacy profile and are generally used to treat the same conditions.

The similar nature of a biosimilar and a reference product is demonstrated by comprehensive comparability studies covering quality, biological activity, safety and efficacy. The minimum expectation of data supplied with the application will include pharmaceutical, chemical, and biological preclinical data, as well as bioequivalence and bioavailability (bodily distribution and concentration) clinical data. The type and amount of additional information, such as toxicological and other preclinical and clinical data, is determined on a case-by-case basis.

European Union legislation provides (with respect to reference products for which a marketing authorization was applied for after October 30, 2005 under the Decentralized, Mutual Recognition and national procedures, or after November 20, 2005, for products authorized under the Centralized Procedure) for an eight-year period of data protection and ten-year period of market exclusivity for medicinal products which received marketing authorization in accordance with, respectively, Directive 2001/83/EC as amended or Regulation (EC) No 726/2004 as amended. The provisions also state that if, during the first eight years of authorization, the holder obtains an authorization for one or more new therapeutic indications which are deemed to have significant clinical benefit as compared to existing therapies, the original market exclusivity can be extended to a maximum of 11 years. The data and market exclusivity periods start from the date of the initial authorization, which for reference medicinal products authorized through the Centralized Procedure is the date of notification of the marketing authorization decision to the marketing authorization holder of the reference product.

Post-Approval Requirements

Once granted, initial marketing authorization of a medicinal product is valid for five years. The authorization may be renewed after five years on the basis of a reevaluation of the risk-benefit balance. At that point, once renewed, the marketing authorization is valid indefinitely or, if justified on grounds of pharmacovigilance, may be restricted to an additional five-year authorization period.

Marketing authorization holders are required to maintain a pharmacovigilance system and to maintain detailed records of all suspected adverse reactions in the EEA or in a third country. Serious suspected adverse reactions are to be communicated to the appropriate EEA regulatory authorities no later than 15 days after receipt of the information. EEA regulations require periodic safety reporting leading up to and following marketing authorization, based on a defined schedule, for as long as the product is marketed, or when immediately requested by regulatory authorities. An increase in incidents of adverse events or any cause for a change in opinion by the EMA pertaining to the risk-benefit balance may lead to suspension, variation, or revocation of marketing authorization and would severely impact our business.

EEA regulations also stipulate that regulators, such as the Competent Authorities of the EEA Member States, independently or coordinated by the EMA, may carry out repeated or unannounced inspections of the medicinal product manufacturer or at the premises of the marketing authorization holder, regarding compliance with cGMP principles and guidelines. Compliance issues identified at our facilities or at third-party manufacturers may disrupt clinical or commercial production or distribution or require substantial resources to correct. This may result in the delay of clinical trials or commercial product launch. Discovery or problems with the product or the failure to comply with applicable requirements may result in restrictions on a product, the manufacturer or the holder of a marketing authorization, including withdrawal or recall of the product from the market or other EMA or EEA Competent Authority initiated action that could delay or prohibit future marketing. Additionally, new government regulations may be established that could delay or prevent regulatory approval of our products under development.

Pharmaceutical Coverage, Pricing and Reimbursement

Significant uncertainty exists as to the coverage and reimbursement status of any products for which we obtain regulatory approval. In the United States and markets in other countries, sales of any products for which we receive regulatory approval for commercial sale will depend in part on the availability of coverage and reimbursement from third-party payors. Third-party payors include government authorities, managed care providers, private health insurers and other organizations. The process for determining whether a payor will provide coverage for a drug product may be separate from the process for setting the reimbursement rate that the payor will pay for the drug product. Third-party payors may limit coverage to specific drug products on an approved list, or formulary, which might not include all of the FDA-approved drugs for a particular indication. Moreover, a payor's decision to provide coverage for a drug product does not imply that an adequate reimbursement rate will be approved. Adequate third-party reimbursement may not be available to enable us to maintain price levels sufficient to realize an appropriate return on our investment in product development.

Third-party payors are increasingly challenging the price and examining the medical necessity and cost-effectiveness of medical products and services, in addition to their safety and efficacy. In order to obtain coverage and reimbursement for any product that might be approved for sale, we may need to conduct expensive pharmacoeconomic studies in order to demonstrate the medical necessity and cost-effectiveness of our products, in addition to the costs required to obtain regulatory approvals. Our product candidates may not be considered medically necessary or cost-effective. If third-party payors do not consider a product to be cost-effective compared to other available therapies, they may not cover the product after approval as a benefit under their plans or, if they do, the level of payment may not be sufficient to allow a company to sell its products at a profit.

The United States government, state legislatures and foreign governments have shown significant interest in implementing cost containment programs to limit the growth of government-paid health care costs, including price controls, restrictions on reimbursement and requirements for substitution of therapeutic equivalent products for branded prescription drugs. The ACA contains provisions that may reduce the profitability of drug products, including, for example, increased the minimum rebates owed by manufacturers under the Medicaid Drug Rebate Program, extended the rebate program to individuals enrolled in Medicaid managed care plans, addressed a new methodology by which rebates owed by manufacturers under the Medicaid Drug Rebate Program are calculated for drugs that are inhaled, infused, instilled, implanted or injected, established mandatory discounts for certain

Medicare Part D beneficiaries and annual fees based on pharmaceutical companies' share of sales to federal health care programs. Furthermore, the current presidential administration and Congress are expected to attempt changes to the current health care laws. We face uncertainties that might result from modification or repeal of any of the provisions of the Affordable Care Act, as amended by the Health Care and Education Reconciliation Act (collectively, the "Affordable Care Act" or the "ACA"), including as a result of current and future executive orders and legislative actions. The impact of those changes on us is currently unknown. But, any changes to the ACA are likely to have an impact on our results of operations, and may have a material adverse effect on our results of operations. We cannot predict what other healthcare programs and regulations will ultimately be implemented at the federal or state level or the effect of any future legislation or regulations in the United States may have on our business.

In the European Union, governments influence the price of pharmaceutical products through their pricing and reimbursement rules and control of national health care systems that fund a large part of the cost of those products to consumers. Some jurisdictions operate positive and negative list systems under which products may only be marketed once a reimbursement price has been agreed to by the government. To obtain reimbursement or pricing approval, some of these countries may require the completion of clinical studies that compare the cost-effectiveness of a particular product candidate to currently available therapies. Other member states allow companies to fix their own prices for medicines, but monitor and control company profits. The downward pressure on health care costs in general, particularly prescription drugs, has become very intense. As a result, increasingly high barriers are being erected to the entry of new products. In addition, in some countries, cross-border imports from low-priced markets exert a commercial pressure on pricing within a country.

The marketability of any products for which we and our collaboration partner receive regulatory approval for commercial sale may suffer if the government and third-party payors fail to provide adequate coverage and reimbursement. In addition, an increasing emphasis on cost containment measures in the United States and other countries has increased and we expect will continue to increase the pressure on pharmaceutical pricing. Coverage policies and third-party reimbursement rates may change at any time. Even if favorable coverage and reimbursement status is attained for one or more products for which we receive regulatory approval, less favorable coverage policies and reimbursement rates may be implemented in the future.

Other Healthcare Laws and Compliance Requirements

If we and our collaboration partners obtain regulatory approval for any of our product candidates, we may be subject to various federal and state laws that may impact, among other things, our or our collaboration partners proposed sales, marketing and education programs. The laws that may affect our operations include:

- The U.S. federal Anti-Kickback Statute, which prohibits, among other things, persons and entities from knowingly and willfully soliciting, receiving, offering or paying remuneration, directly or indirectly, to induce, or in return for, either the referral of an individual for, or the purchase or recommendation of any good or service for which payment may be made, in whole or in part, by federal healthcare programs, such as Medicare and Medicaid programs. This statute has been interpreted to apply to arrangements between pharmaceutical companies on one hand and prescribers, purchasers and formulary managers on the other. Liability under the Anti-Kickback Statute may be established without proving accrual knowledge of the statute or specific intent, to violate it. In addition, the government may assert that a claim including items or services resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the federal civil False Claims Act;
- Federal civil False Claims Act, which prohibits, among other things, individuals or entities from knowingly presenting, or causing to be presented, a false or fraudulent claim for payment of government funds, or knowingly making, using or causing to be made or used a false record or statement material to an obligation pay money to the government or knowingly concealing or knowingly and improperly avoiding, decreasing or concealing an obligation to pay money to the

federal government. Private individuals, commonly known as "whistleblowers," can bring FCA qui tam actions on behalf of the government and such individuals and may share in amounts paid by the entity to the government in recovery or settlement. In addition, a claim including items or services resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the federal civil False Claims Act. False Claims Act liability is potentially significant in the healthcare industry because the statute provides for treble damages and significant mandatory penalties per false claim or statement for violations. Criminal penalties, including imprisonment and criminal fines, are also possible for making or presenting a false, fictitious or fraudulent claim to the federal government;

- The federal Health Insurance Portability and Accountability Act of 1996, as amended by the Health Information Technology and Clinical Health Act (HITECH), (collectively referred to as HIPAA), imposes criminal and civil liability for, among other things executing a scheme to defraud any healthcare benefit program and knowingly and willfully falsifying, concealing or covering up a material fact in connection with the delivery of or payment for healthcare benefits, items or services. We may obtain health information from third parties, such as research institutions, that are subject to privacy and security requirements under HIPAA. Although we are not directly subject to HIPAA, other than with respect to providing certain employee benefits, we could potentially be subject to criminal penalties if we, our affiliates, or our agents knowingly obtain or disclose individually identifiable health information maintained by a HIPAA covered entity in a manner that is not authorized or permitted by HIPAA;
- The federal Physician Payment Sunshine Act implemented as the Open Payments Program that requires certain manufacturers of drugs, devices, biologics and medical supplies for which payment is available under Medicare, Medicaid or the Children's Health Insurance Program (with certain exceptions) to report annually to the United States Department of Health and Human Services, Centers for Medicare and Medicaid Services, information related to payments and other transfers of value provided to physicians and teaching hospitals as well as ownership and investment interests held by such physicians and their immediate family members. Beginning in 2022, applicable manufacturers also will be required to report information regarding payments and transfers of value provided to physician assistants, nurse practitioners, clinical nurse specialists, certified nurse anesthetists, and certified nurse-midwives; and
- State law equivalents of each of the above federal laws, such as anti-kickback and false claims laws which may apply to items or services reimbursed by any third-party payor, including commercial insurers; state laws that require pharmaceutical companies to comply with the pharmaceutical industry's voluntary compliance guidelines and the relevant compliance guidance promulgated by the federal government, or otherwise restrict payments that may be made to healthcare providers and other potential referral sources; state laws that require drug manufacturers to report information related to payments and other transfers of value to physicians and other healthcare providers or marketing expenditures; and state laws governing the privacy and security of health information in certain circumstances, many of which differ from each other in significant ways and may not have the same effect, thus complicating compliance efforts.

Because of the breadth of these laws and the narrowness of the statutory exceptions and safe harbors available, it is possible that some of our future business activities could be subject to challenge under one or more of such laws.

We and our collaboration partners also may be subject to the Foreign Corrupt Practices Act, or FCPA, which prohibits improper payments or offers of payments to foreign governments and their officials for the purpose of obtaining or retaining business. Safeguards implemented to discourage improper payments or offers of payments by our or our collaboration partners' employees, consultants, and others may be ineffective, and violations of the FCPA and similar laws may result in severe criminal or civil sanctions, or other liabilities or

proceedings against us or our collaboration partners, any of which would likely harm our or our collaboration partners' reputation, business, financial condition and result of operations.

If our operations are found to be in violation of any of the laws described above or any other governmental regulations that apply to us, we may be subject to penalties, including civil and criminal penalties, exclusion from participation in government healthcare programs, such as Medicare and Medicaid and imprisonment, damages, fines and the curtailment or restructuring of our operations, any of which could adversely affect our ability to operate our business and our results of operations.

Hazardous Materials

Our research and development processes may involve the controlled use of hazardous materials and chemicals. We are subject to federal, state and local laws and regulations governing the use, manufacture, storage, handling and disposal of hazardous materials and waste products. We cannot predict how changes in laws or development of new regulations will affect our business operations or the cost of compliance.

Competition

The development and commercialization of protein therapeutics is highly competitive. While we believe that our *Pf*ēnex Expression Technology ®, knowledge, experience and scientific resources provide us with competitive advantages, we face potential competition from many different sources, including major pharmaceutical, generic pharmaceutical, specialty pharmaceutical and biotechnology companies. In the event that we and our collaboration partners were to market and sell any of our biopharmaceutical products, we would face competition from the companies producing branded reference drugs, as well as biosimilars, therapeutic equivalents, and other products that would compete with our product candidates, if approved. For example, PF708, our teriparatide 505(b)(2) candidate, may face competition from the reference product sponsor, Eli Lilly, or other competition from companies like Teva and Gedeon Richter Plc., and from Amgen Inc. and Radius Health, Inc. as developers of novel products. For example, in April 2017, the FDA approved Radius Health's TYMLOS®, and Amgen and UCB are developing Evenity (romosozumab), which is expected to be approved by the FDA in the second half of 2019, each of which could potentially compete with PF708. Key competitive factors affecting the success of our product candidates, if approved, are likely to be price, the level of biosimilar, therapeutic equivalent and novel product competition and the availability of coverage and reimbursement from government and other third-party payors.

Similarly, our novel vaccine development programs face substantial competition from major pharmaceutical and other biotechnology companies that are actively working on improved and novel vaccines. We believe that our primary competitors include Emergent BioSolutions, Inc. and Altimmune, Inc. These companies are receiving funding from BARDA for the development of next generation anthrax vaccines. All of our novel vaccine efforts will face competition for limited government funding from other non-vaccine defensive measures as well, including medical countermeasures for biological, chemical and nuclear threats, diagnostic testing systems and other emergency preparedness countermeasures.

Further, many of our competitors, either alone or with their strategic partners, have substantially greater financial, technical and human resources than we do and significantly greater experience in the discovery and development of product candidates, obtaining FDA and other regulatory approvals of treatments and commercializing those treatments. Accordingly, our competitors may be more successful than we are in obtaining approval for treatments and achieving widespread market acceptance. Our competitors' treatments may be more effective or more effectively marketed and sold than any treatment we may commercialize and may render our treatments obsolete or non-competitive before we can recover the expenses of developing and commercializing any of our product candidates. For further discussion of risks related to government contracting, see the discussion in Item 1A, "*Risk Factors*" in this Form 10-K.

Mergers and acquisitions in the biotechnology and pharmaceutical industries may result in even more resources being concentrated among a smaller number of our competitors. These competitors also compete with

us in recruiting and retaining qualified scientific and management personnel and establishing clinical study sites and subject registration for clinical studies, as well as in acquiring technologies complementary to or necessary for our programs. Smaller or early-stage companies may also prove to be significant competitors, particularly through collaborative arrangements with large and established companies.

Sales and Marketing

To date, none of our product candidates have received marketing authorization from any regulatory agency, and therefore we have not received revenue from the sale of any of our product candidates. For our product candidates, we generally seek to license rights regionally to commercially proficient partners. To the extent that we retain commercial rights to product candidates, we intend to use an internal sales force to commercialize products for which we may receive marketing approvals in territories in which we believe it is possible to access the market through a focused, specialty sales force.

For PF708, in June 2018, we and Alvogen entered into a Development and License Agreement (US Alvogen Agreement) pursuant to which Alvogen has the exclusive right to commercialize and manufacture PF708 in the United States. In February 2019, we and Alvogen, through certain of its subsidiaries, entered into agreements expanding our and Alvogen's collaboration to develop and commercialize PF708 to the EU, MENA, and the rest of the world other than the territory covered by our agreement with NT Pharma. We believe this collaboration leverages Alvogen's established international experience and expertise in regulatory, IP and supply chain activities, as well as its established network of specialty marketing and sales pharmaceutical companies in these regions. Subject to applicable regulatory approvals, PF708 will be commercialized in Europe and Switzerland by Theramex, a leading global specialty pharmaceutical company dedicated to Women's Health, in MENA by SAJA, a Tamer Group company, and in ROW by Alvogen's current and/or future commercialization partners. Under the terms of the agreements, Alvogen will be responsible for the local activities through Theramex, SAJA and its other commercialization partners and for overseeing any clinical development, regulatory, litigation, commercial manufacturing and commercialization. We will continue to be responsible for development and registration of PF708, while Alvogen will provide additional regulatory and development expertise.

In addition, in April 2018, we and NT Pharma entered into a Development and License Agreement, pursuant to which we granted an exclusive license to NT Pharma to commercialize PF708 in Mainland China, Hong Kong, Singapore, Malaysia and Thailand and a non-exclusive license to conduct development activities in such territories with respect to PF708. We will be responsible for commercial manufacturing and will provide NT Pharma with the product for commercial sale. NT Pharma will be responsible for all regulatory submissions, development costs and costs associated with regulatory approvals in such territories.

Upon marketing approval for products developed under our collaboration with Jazz, Jazz will assume responsibility for the manufacturing and commercialization of certain hematology/oncology products globally. Given the initial emerging markets focus for those products, we generally expect to jointly seek collaboration, distribution and/or marketing arrangements with third parties.

We have sales and marketing capabilities to support our commercial efforts for our protein production services and reagent protein product sales. In addition, we have sales and marketing capabilities to support those products under development that receive FDA approval that will ultimately be procured by the United States government.

Intellectual Property

We strive to protect and enhance the proprietary technologies that we believe are important to our business and seek to obtain and maintain patents for any patentable aspects of our platform technology and our products or product candidates, their methods of use and any other inventions that are important to the development of our business. Our success depends substantially on our ability to obtain and maintain patent and other proprietary

protection for our technology and product candidates, to defend and enforce our patents to prevent others from infringing our proprietary rights, maintain our licenses to use intellectual property owned by third parties, preserve the confidentiality of our trade secrets and to operate without infringing on the valid and enforceable patents and other proprietary rights of third parties. Our policy is to seek to protect our proprietary position by, among other methods, filing United States and foreign patent applications related to our proprietary technology and product candidates that are important to the development of our business. We also rely on trade secrets, know-how, continuing technological innovation and in-licensing opportunities to develop and maintain our proprietary position relating to our platform technology and product candidates.

We are the owner or licensee of a portfolio of patents and patent applications and possess substantial know-how and trade secrets which protect various aspects of our business. As of December 31, 2018, we were the sole owner of a patent portfolio that consisted of a total of 24 U.S. issued patents and six U.S. non-provisional patent applications that provide material coverage for our platform technology and our lead product candidates as well as foreign granted and pending patent applications which are counterparts to certain of the foregoing U.S. patents and patent applications. Our U.S. issued patents expire during the time period beginning in 2023 and ending in 2036. Our owned and exclusively licensed patent portfolio includes claims directed to:

- methods for bacterial protein production and methods for rapid screening of an array of expression systems
- *P. fluorescens* promoter sequences and secretion leader sequences
- auxotrophic marker systems for antibiotic free maintenance of expression plasmids in high cell density cultures,
- improved incorporation of non-natural amino acids
- expression of classes of proteins such as cytokines
- antibody derivatives
- microbial toxins in *P. fluorescens*
- methods and expression strains for production and/or purification of soluble full length human cytokines, Interferon beta and G-CSF
- vaccine antigens recombinant anthrax protective antigen, microbial toxins and toxoids, and the malarial vaccine candidate antigen *P. falciparum* circumsporozoite protein (CSP)
- fusion partners for peptide production

Pursuant to the technology licensing agreement, The Dow Chemical Company, or TDCC, and Dow Global Technologies LLC, or DGTI, also grant to us non-exclusive licenses to U.S. patents and applications and their foreign counterparts covering methods and technologies for recovery of proteins and peptides from *P. fluorescens* cells. In conjunction with the licenses granted by TDCC and DGTI to us under the technology licensing agreement, we also entered into a grant-back and technology license agreement, pursuant to which we granted to TDCC exclusive and non-exclusive licenses under certain patent rights and know-how relating to our *Pf*ēnex Expression Technology® to use certain biological materials to make, use and commercialize products in certain fields of use that do not include human therapeutics. See "Business—Collaborations, Joint Development and Licenses" for a detailed description of our agreements with TDCC and DGTI.

The patent positions of companies like ours are generally uncertain and involve complex legal and factual questions. Our ability to obtain and maintain our proprietary position for our technology will depend on our success in obtaining issued claims that cover our technology and product candidates, and being able to enforce those claims against our competitors once granted. We do not know whether any of our pending patent applications will result in the issuance of any patents. Moreover, even our issued patents do not guarantee us the right to practice the patented technology in relation to the commercialization of our product candidates. Third

parties may have blocking patents that could be used to prevent us from commercializing our patented products and practicing our patented technology. Our issued patents and those that may be issued in the future may be challenged, invalidated or circumvented, which could limit our ability to stop competitors from marketing related products or the length of the term of patent protection that we may have for our products. In addition, the rights granted under any issued patents may not provide us with proprietary protection or competitive advantages against competitors with similar technology. Furthermore, our competitors may independently develop similar technologies. For these reasons, we may have competition for both our biosimilar and vaccine products. Moreover, because of the extensive time required for development, testing and regulatory review of a potential product, it is possible that, before any of our products can be commercialized, any related patent may expire or remain in force for only a short period following commercialization, thereby reducing any advantage of the patent.

We may rely, in some circumstances, on trade secrets to protect our technology. However, trade secrets are difficult to protect. We seek to protect our technology and product candidates, in part, by entering into confidentiality agreements with those who have access to our confidential information, including our employees, consultants, advisors, contractors and collaborators. We also seek to preserve the integrity and confidentiality of our proprietary technology and processes by maintaining physical security of our premises and physical and electronic security of our information technology systems. While we have confidence in these individuals, organizations and systems, agreements or security measures may be breached and we may not have adequate remedies for any breach. In addition, our trade secrets may otherwise become known or be independently discovered by competitors. To the extent that our employees, consultants, advisors, contractors and collaborators use intellectual property owned by others in their work for us, disputes may arise as to the rights in related or resulting know-how and inventions. For this and more comprehensive risks related to our proprietary technology and processes, please see "*Risk Factors—Risks Relating to Our Intellectual Property.*"

Environmental Matters

Our research and development and manufacturing activities and our third-party manufacturers' and suppliers' activities involve the controlled storage, use and disposal of hazardous materials owned by us, including, small quantities of acetonitrile, methanol, ethanol, ethidium bromide and compressed gases, and other hazardous compounds. We and our manufacturers and suppliers are subject to laws and regulations governing the use, manufacture, storage, handling and disposal of these hazardous materials. In some cases, these hazardous materials and various wastes resulting from their use are stored at our and our manufacturers' facilities pending their use and disposal. We seek to comply with applicable laws regarding the handling and disposal of such materials. Given the small volume of such materials used or generated at our facilities, we do not expect our compliance efforts to have a material effect on our capital expenditures, earnings, and competitive position. However, we cannot eliminate the risk of accidental contamination or discharge and any resultant injury from these materials. We do not currently maintain separate environmental liability coverage and any such contamination or discharge could result in significant cost to us in penalties, damages, and suspension of our operations.

Suppliers

We currently rely on, and expect to continue to rely on, contract manufacturers to produce sufficient quantities of our product candidates for use in our clinical trials. With the exception of PF708 for which we have granted Alvogen the exclusive rights to commercialize for select territories, we intend to rely on third parties to manufacture any products that we may commercialize in the future. We have established an internal pharmaceutical development group to develop manufacturing methods for our product candidates, to optimize manufacturing processes, and to select and transfer these manufacturing technologies to our suppliers. We contract with multiple manufacturers to ensure adequate product supply and to mitigate risk.

There currently are a limited number of these manufacturers. Furthermore, some of the contract manufacturers that we have identified to date only have limited experience at manufacturing, formulating,

analyzing and packaging our product candidates in quantities sufficient for conducting clinical trials or for commercialization. For further discussion of risks related to government contracting, see the discussion in Item 1A, "*Risk Factors*" in this Form 10-K.

Manufacturing

We do not own or operate facilities for cGMP manufacturing of any products. Although we intend to rely on Alvogen, our collaboration partners, and contract manufacturers, we have personnel with experience in the development of United States and European Union cGMP-compliant processes and management of Contract Manufacturing Organizations (CMOs), to oversee the technology transfer to the manufacturers of PF708, Px563L and other product candidates that we may develop. For example, we are currently working with Alvogen to transfer the manufacturing of PF708. Our manufacturing processes employ standard equipment common to CMOs. Our processes also use common and widely available materials, and our well-established manufacturing procedures are robust, scalable, and readily transferable to support our clinical development programs and commercialization of our products. We believe that there are alternate sources of supply that can satisfy our clinical and commercial requirements, although we cannot be certain that identifying and establishing relationships with such sources, if necessary, would not result in significant delay or material additional costs. For a discussion of risks related to our sources and availability of supplies, see *"Risk Factors—Risks Relating to our Reliance on Third Parties—We rely on third-party suppliers, Alvogen, and other collaboration partners, and in some instances a single third-party supplier, for the manufacture and supply of certain materials in our protein production services, and these suppliers could cease to manufacture the materials, go out of business or otherwise not perform as anticipated."*

In each of our agreements with contract manufacturers, we retain ownership of our intellectual property and generally own and/or are assigned ownership of processes, developments, data, results and other intellectual property generated during the course of the performance of each agreement that primarily relate to our products. Where applicable, we are granted non-exclusive licenses to certain contract manufacturer intellectual property for purposes of exploiting the products that are the subject of the agreement, and in a few instances, we grant non-exclusive licenses to the contract manufacturers for use outside of our product area. In each contract, we have the right to terminate for convenience. The agreements also contain typical provisions for both parties to terminate for material breach, and bankruptcy and insolvency.

Protein Production

Utilizing our *Pf*ēnex Expression Technology®, we provide protein production and process development services to third parties on a fee for service basis in support of the development of novel biopharmaceuticals. Pursuant to a license agreement, the third-party licenses a production strain from us and then pays us an up-front payment, milestone payments based upon clinical progression and regulatory filings, and a royalty based on product net sales. Our protein production efforts enable us to maximize the utilization of our *Pf*ēnex Expression Technology ®, expand our institutional knowledge and generate revenue.

Seasonality

Our revenues are not seasonal in nature.

U.S. Government Contracts

Revenue from U.S. Government Contracts varies by year. A portion of our government business is subject to renegotiation of profits or termination of contracts or subcontracts at the election of the U.S. Government. In addition to contract terms, we must comply with procurement laws and regulations relating to the formation, administration, and performance of U.S. Government contracts. Failure to comply with these laws and regulations could lead to the termination of contracts at the election of the government or the suspension or

debarment from U.S. Government contracting or subcontracting. U.S. Government revenue as a percentage of our total revenue was approximately 32%, 20% and 10% for fiscal years 2018, 2017 and 2016, respectively. For further discussion of risks related to government contracting, see the discussion in Item 1A, "*Risk Factors*" in this Form 10-K.

Employees

We believe that our success will depend greatly on our ability to identify, attract and retain capable employees. As of December 31, 2018, we had 71 employees, including a total of 14 employees who hold Ph.D. degrees. Our employees are not represented by any collective bargaining unit, and we believe our relations with our employees are good.

Backlog

We have no material backlog of orders.

Corporate Information

We were founded in November 2009 as a Delaware corporation spun out of The Dow Chemical Company. Our principal executive offices are located at 10790 Roselle St., San Diego, California 92121 and our telephone number is (858) 352-4400. Our website is www.pfenex.com. We make available on our website, free of charge, our Annual Report on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K, and any amendments to those reports, as soon as reasonably practicable after we electronically file such material with, or furnish it to, the Securities and Exchange Commission (SEC). Our SEC reports can be accessed through the investor relations page of our website located at http://pfenex.investorroom.com.

We webcast our earnings calls and certain events we participate in or host with members of the investment community on our investor relations page of our website. Corporate governance information, including our board committee charters, code of ethics and conduct, and corporate governance principles, is also available on our investor relations page of our website located at http://pfenex.investorroom.com/corporate-governance. In addition, we use our website (http://www.pfenex.com), our investor relations website (http://pfenex.investorroom.com), press releases, SEC filings, public conference calls, corporate Twitter account (https://twitter.com/pfenex), Facebookpage (https://www.facebook.com/Pfenex-Inc-105908276167776/timeline), and LinkedIn page (https://www.linkedin.com/company/pfenex-inc) in order to achieve broad, non-exclusionary distribution of information to the public. We encourage our investors and others to review the information we make public in these locations as such information could be deemed to be material information. Please note that this list may be updated from time to time.

The contents of our website and the information we post through social media are not a part of, and are not incorporated by reference into, this Annual Report on Form 10-K or any other report or document we file with the SEC, and any references to our website and social media sites are intended to be inactive textual references only.

Pfenex™, the Pfenex logo and other trademarks or service marks of Pfenex appearing in this Annual Report on Form 10-K are the property of Pfenex Inc. Trade names, trademarks and service marks of other companies appearing in this Annual Report on Form 10-K are the property of their respective holders.

Executive Officers

The following table identifies certain information about our executive officers as of March 2, 2019.

Name	Age	Position
Evert B. Schimmelpennink	47	Chief Executive Officer, President and Secretary
Susan A. Knudson	55	Chief Financial Officer
Patrick K. Lucy	51	Chief Business Officer
Dr. Shawn A. Scranton	55	Chief Operating Officer

Evert B. Schimmelpennink has served as our Chief Executive Officer, President and Secretary since August 2017. Prior to his appointment, Mr. Schimmelpennink served as the Chief Executive Officer of Alvotech, a biosimilar development company from 2015 to July 2017. From September 2015 to November 2015, Mr. Schimmelpennink served as Vice President—Global Sterile Injectables of Pfizer Inc., a pharmaceutical company. Prior to that, Mr. Schimmelpennink served as Vice President—Global Generics from 2012 to 2015 and Director of Specialty Injectable Pharma Marketing EMEA & Director of Distributor Operations EMEA from 2011 to 2012 of Hospira, Inc., a pharmaceutical company. From 2002 to 2011, Mr. Schimmelpennink held various roles at Synthon BV, a generics medicine company, including Vice President Marketing and Sales from 2008 to 2011. From 1997 to 2002 he held various roles with Numico NV, a Dutch maker of baby foods and nutritional bars and shakes, including International Product Manager from 2000 to 2002 and Researcher Product Development from 1999 to 2000. Prior to Numico, Mr. Schimmelpennink served as a vaccine technologist at the Dutch National Institute for Public Health and the Environment from 1998 to 1999. Mr. Schimmelpennink received a Masters in bioprocess engineering from the Wageningen University in the Netherlands. The board of directors believes Mr. Schimmelpennink is qualified to serve as a director because of his extensive knowledge of our industry and his prior and current experience as a senior officer of healthcare companies.

Susan A. Knudson has served as our Chief Financial Officer since February 2018. From 2009 to 2017, Ms. Knudson held various roles at Neothetics, Inc., a specialty pharmaceutical company, including Chief Financial Officer from 2014 to 2017 and Vice President of Finance and Administration from 2009 to 2014. Prior to joining Neothetics, Ms. Knudson served as Senior Director of Finance and Administration at Avera Pharmaceuticals, a pharmaceutical company, from May 2002 to January 2009. Prior to May 2002, Ms. Knudson served as Director of Finance and Administration at MD Edge, Inc., a medical communications company, from October 2000 to April 2002. Prior to joining MD Edge, Ms. Knudson served as Assistant Director of Accounting at Isis Pharmaceuticals, a pharmaceutical company, from April 2000 to October 2000. Ms. Knudson has also held senior positions at CombiChem, General Atomics and Deloitte & Touche. Ms. Knudson holds a B.A. in Accounting from the University of San Diego.

Patrick K. Lucy has served as our Chief Business Officer since 2014. Mr. Lucy also served as our Interim Chief Executive Officer, President and Secretary from January 2017 to August 2017, when Mr. Schimmelpennink was appointed to those roles. Mr. Lucy previously served as our Vice President of Business Development and Marketing between 2009 and 2014. Prior to joining us, Mr. Lucy held the position of Director of Business Development at DowPharma, a business within The Dow Chemical Company, a chemicals manufacturer, from 2002 to 2009. From 1999 to 2002, he held the position of Director of Business Development at Collaborative BioAlliance, Inc., a biotechnology company, which was acquired by The Dow Chemical Company. From 1998 to 1999, Mr. Lucy worked as a Validation Manager and Capital Project Manager and from 1996 to 1998, as a Quality Control Biochemistry Supervisor at Lonza Biologics Inc., a chemicals and biotechnology company. From 1991 to 1996, Mr. Lucy held various positions at Repligen Corporation, a life sciences company. Mr. Lucy holds a Bachelor's degree in Biology from Villanova University.

Dr. Shawn A. Scranton has served as our Chief Operating Officer since October 2018. He previously served as Chief Scientific Consultant for Sentynl Therapeutics, Inc. a wholly owned subsidiarity of Zydus-Cadila, a pharmaceutical company, from 2017 to 2018. From 2015 to 2017, Dr. Scranton served as Senior Vice President,

Chief Scientific Officer at Sentynl Therapeutics, Inc., a pharmaceutical company. Prior to Sentynl, Dr. Scranton served as Consultant, Managing Director at Strategic Therapeutic Solutions, LLC, a pharmaceutical consulting company, and from 2007 to 2012, Dr. Scranton served as VP, Scientific Operations at Victory Pharma, Inc., a specialty pharmaceutical company. Dr. Scranton served as Sr. Director of Translational Medicine at Kalypsys, Inc., a pharmaceutical company, from 2005 to 2007, and as Director of Clinical Research/Program Director at Salmedix Corporation, a drug development company, from 2001 to 2005. From 1998 to 2000, Dr. Scranton served as Senior Clinical Research Scientist, Clinical Development at Dura Pharmaceuticals, Inc., a pharmaceutical company. Dr. Scranton holds a Doctor of Pharmacy from the University of the Pacific School of Pharmacy (1994) and a B.A. in Animal Physiology from the University of California, San Diego (1988).

Item 1A. ***Risk Factors***

RISK FACTORS

Investing in our common stock involves a high degree of risk. You should carefully consider the risks and uncertainties described below, together with all of the other information in this Annual Report on Form 10-K, before making an investment decision. The risks and uncertainties described below may not be the only ones we face. If any of the risks actually occur, our business, financial condition, operating results, cash flows and prospects could be materially and adversely affected. In that event, the market price of our common stock could decline, and you could lose part or all of your investment.

Risks Relating to our Financial Condition and Need for Additional Capital

We have a limited operating history and expect to generate significant losses for the foreseeable future. If we do not generate significant revenue, we will not be profitable.

With the exception of two years, we have incurred annual net operating losses since inception, and to date have generated only limited revenue from government contracts, service agreements, collaboration agreements, and reagent protein product sales. We have recognized net losses of $39.6 million and $25.7 million for the years ended December 31, 2018 and 2017, respectively, and net income of $5.5 million for the year ended December 2016. As of December 31, 2018, we had an accumulated deficit of $201.3 million and net working capital of $46.2 million. To date, we have funded our operations primarily through the sale and issuance of common stock in our public offerings, revenue from our collaboration agreements, government contracts, service agreements, and reagent protein product sales, our prior credit facility and the private placement of equity securities. As of December 31, 2018, we had capital resources consisting of cash and cash equivalents of $56.2 million. As we continue to develop and invest more resources into the development and commercialization of our product candidates, our net operating losses will increase over the next several years. To become profitable, we must successfully develop and obtain regulatory approval for our product candidates, and effectively manufacture and commercialize the product candidates we develop. We submitted our NDA for PF708 on December 10, 2018 and the FDA accepted our submission for substantive review in February 2019. If we obtain regulatory approval to market PF708, or any other product candidate, our future revenue will depend upon the size of any markets in which PF708, or such other product candidate may receive approval, and our and our collaboration partners' ability to achieve sufficient market acceptance, pricing, reimbursement from third-party payors, and adequate market share for our product candidates in those markets. We and our collaboration partners may never succeed in these activities and therefore may never generate revenue that is significant or large enough to achieve profitability. Even if we do achieve profitability, we may not be able to sustain or increase profitability on a quarterly or annual basis. Our failure to become and remain profitable could depress the market price of our common stock and could impair our ability to raise capital, expand our business, diversify our product offerings or continue our operations.

We will require substantial additional funds to seek and obtain regulatory approval for and commercialize our product candidates and, if additional capital is not available, we may need to limit, scale back or cease our operations.

Since our inception, a significant portion of our resources have been dedicated to the preclinical and clinical development of our product candidates, including PF708, Px563L, RPA563, PF582, and PF529. We believe that we will continue to expend substantial resources for the foreseeable future for the preclinical and clinical development of our current product pipeline, and the development of any other indications and product candidates we may choose to pursue, either alone or with a strategic collaboration partner. These expenditures will include costs associated with research and development, conducting preclinical studies and clinical studies, and manufacturing and supply as well as marketing and selling any products that receive marketing authorization. Because the outcome of any clinical trial is highly uncertain, we cannot reasonably estimate the actual amounts necessary to successfully complete the development and commercialization of PF708, Px563L,

RPA563, and our pipeline of other product candidates and preclinical products under development. Following our strategic review in November 2017, we decided to pause our development activities for PF582 and PF529 and focus our efforts and resources elsewhere in the product portfolio until strategic partnerships for these candidates are forged. In the future, we may be required to devote additional resources to the development of PF582 or PF529, or obtain a new collaboration partner on short notice, and the terms of any additional collaboration or other arrangements that we establish may not be favorable to us. We may also need to obtain substantial additional sources of funding to develop our product candidates as currently contemplated. If such additional funding is not available on favorable terms or at all, we may need to delay or reduce the scope of our product candidate development programs, or grant rights in the United States, as well as outside the United States, to our product candidates to one or more partners.

We believe that our available cash and cash equivalents, including the proceeds from any revenue from our government contracts, service agreements, collaboration agreement, and reagent protein product sales, will be sufficient to meet our anticipated cash needs for at least the next twelve months. We believe we have sufficient cash resources to fund all necessary activities leading up to and including meeting our obligations to contractually support our partner on the potential commercial launch of PF708 in the United States as early as the fourth quarter of 2019, subject to FDA approval of the new drug application and other factors. However, changing circumstances and risks and uncertainties associated with our product development efforts may cause us to consume capital significantly faster than we currently anticipate, and we may need to spend more money than currently expected. Our future capital requirements may vary depending on the following:

- the timing and extent of spending on our research and development efforts, including with respect to PF708 and our other product candidates;
- our ability to enter into and maintain collaboration, licensing, commercialization and other arrangements and the terms and timing of such arrangements;
- the cost of manufacturing and commercialization activities, if any;
- the receipt of any collaboration or milestone payments;
- the scope, rate of progress, results and FDA acceptance of the results, and cost of our clinical trials, preclinical testing and other related activities for our product candidates;
- the emergence of competing technologies or other adverse market developments;
- the time and costs involved in seeking and obtaining regulatory and marketing approvals in multiple jurisdictions for our product candidates that successfully complete clinical trials;
- the cost of preparing, filing, prosecuting, defending and enforcing any patent claims and other intellectual property rights;
- the introduction of new product candidates and the number and characteristics of product candidates that we pursue;
- the timing, receipt and amount of sales, profit sharing or royalties, if any, from our potential products;
- if approved, the degree and rate of market acceptance of any products launched by us or our collaboration partners;
- the expansion of our sales and marketing activities; and
- the potential acquisition and in-licensing of other technologies, products or assets.

If we were to experience any delays or encounter issues with any of the above, including clinical holds, failed studies, inconclusive or hard-to-interpret results, safety or efficacy issues, or other regulatory challenges that require longer follow-up of existing studies, additional major studies, or additional supportive studies in order to pursue marketing approval, it could further increase the costs associated with the above and delay revenues.

We will need to raise additional capital to fund our operations in the near future. If we seek additional funding in the future, additional funds may not be available to us on acceptable terms or at all. We may seek to raise additional funds through equity, equity-linked or debt financings. If we raise additional funds through the incurrence of indebtedness, such indebtedness would have rights that are senior to holders of our equity securities and could contain covenants that restrict our operations. We have a sales agreement in place with William Blair to sell up to $20.0 million worth of shares of our common stock, from time to time, through an "at the market" equity offering program under which William Blair will act as sales agent. As of December 31, 2018, $20.0 million worth of shares of our common stock remained available for sale under the "at the market" equity offering program. Any additional equity financing may be dilutive to our stockholders. If we are unable to obtain funding on a timely basis, we may be required to significantly curtail the advancement of one or more of our product candidates. We also could be required to seek funds through arrangements with collaboration partners or others that may require us to relinquish rights to some of our technologies or product candidates which we would otherwise pursue on our own.

Any further development of PF582 and PF529 will require significant resources from us or another collaboration partner, and in the event that we do not find a collaboration partner, the development of PF582 and PF529 could be significantly delayed or result in the discontinuation of the development of PF582 and PF529.

In November 2017, we completed our strategic review of PF582 and PF529, our biosimilar product candidates to Lucentis ® and Neulasta®, respectively. The strategic review considered the timeline for development and cost of both programs. As a result of our strategic review, we decided to pause development activities on PF582 and PF529 and focus development efforts elsewhere within the product portfolio while we continue to engage potential strategic partners to monetize PF582 and PF529. Further development of PF582 and PF529 will require significant resources from us or another collaboration partner. We or a new collaboration partner will be responsible for funding any new PF582 and PF529 development and clinical trial activities going forward. Any such further development will require significant resources to develop and commercialize PF582 and PF529, and such further development may not be possible in the near term without a new collaboration partner**.** There are no assurances that we will have access to additional capital or find a new collaboration partner or that the terms and timing of any such arrangements would be acceptable to us. As a result, we could experience a significant delay in the PF582 and PF529 development processes. If we determine instead to discontinue the development of PF582 or PF529, we will not receive any future return on our investment from that product candidate.

Our quarterly operating results may fluctuate significantly.

Our operating results are subject to quarterly fluctuations. Our operating results are affected by numerous factors, including:

- variations in the level of expenses related to our PF708, Px563L, RPA563 and other development and future commercialization programs;
- addition or termination of clinical trials;
- any intellectual property infringement lawsuit in which we may become involved;
- regulatory developments affecting any of our products; and
- our execution of any service, collaborative, licensing or similar arrangements, and the timing of payments we may make or receive under these arrangements.

If our quarterly operating results fall below the expectations of investors or securities analysts, the market price of our common stock could decline substantially. Furthermore, any quarterly fluctuations in our operating results may, in turn, cause the market price of our stock to fluctuate substantially.

Risks Relating to our Business and our Industry

Our business operations are dependent upon our senior management team and the ability of our other employees to execute on our business strategy. If we fail to attract, integrate, and keep senior management and key scientific personnel, we may be unable to successfully develop PF708, Px563L, RPA563 or any other product candidates, conduct our clinical trials and commercialize PF708, Px563L, RPA563 or any other product candidates we develop.

Our success depends in part on our continued ability to attract, integrate, retain, and motivate highly qualified management, clinical and scientific personnel, including our ability to develop an effective working relationship among senior management. Our senior management has substantially changed since the beginning of the last two fiscal years, including, for example, the departures of our former chief executive officer, Bertrand Liang, former chief financial officer, Paul Wagner, former chief manufacturing officer, Steven Sandoval in 2017 and former chief medical and scientific officer, Hubert Chen, in 2018. Dr. Chen continues to support the Company as an advisor. We have a new president and chief executive officer, Eef Schimmelpennink, who started in August 2017, a new chief financial officer, Susan Knudson, who started in February 2018, and a new chief operating officer, Dr. Shawn Scranton who started in October 2018.

As new employees gain experience in their roles, we could experience inefficiencies or a lack of business continuity due to loss of historical knowledge and a lack of familiarity of new employees with business processes, operating requirements, policies and procedures, and we may experience additional costs as new employees gain necessary experience. It is important to our success that these key employees quickly adapt to and excel in their new roles. If they are unable to do so, our business and financial results could be materially adversely affected. In addition, the loss of the services of any member of our senior management or our scientific or technical support staff might significantly delay or prevent the development of our products or achievement of other business objectives by diverting management's attention to transition matters and identification of suitable replacements, if any, and could have a material adverse effect on our business.

We believe that our future success is highly dependent upon the contributions of our senior management, particularly our Chief Executive Officer, Chief Financial Officer, Chief Business Officer, and Chief Operating Officer, as well as our senior scientists and other members of our senior management team. Employment agreements with our Chief Executive Officer, Chief Financial Officer, Chief Business Officer, and Chief Operating Officer, as well as our offer letters with our senior scientists, all provide for "at-will" employment. The loss of services of any of these individuals could delay or prevent the successful development of our product pipeline, completion of our planned clinical trials or the commercialization of PF708, Px563L, RPA563, or any other products we develop.

Competition for qualified personnel in the biotechnology and pharmaceuticals industry is intense due to the limited number of individuals who possess the skills and experience required. To help attract, retain, and motivate qualified employees, we use share-based incentive awards such as employee stock options. Other companies may provide more generous compensation and benefits, more diverse opportunities and better chances for career advancement than we do. Some of these advantages may be more appealing to high-quality candidates and employees than those we have to offer. In addition, the decline in our stock price has created additional challenges related to our ability to compete effectively with respect to equity compensation. We may need to hire additional personnel as we expand our clinical development and commercial activities. We may not be able to attract and retain quality personnel on acceptable terms, or at all, which may cause our business and operating results to suffer.

If an improved version of a reference product or reference listed drug, such as Forteo, is developed, or if the market for a reference product or reference listed drug significantly declines, sales or potential sales of our therapeutic equivalent product candidates may suffer.

Reference product or reference listed drug ("originator") sponsor companies may develop improved versions as part of a life cycle extension strategy and may obtain regulatory approval of the improved version

under a supplemental biologics license application (BLA) or NDA. If an originator sponsor company succeeds in obtaining an approval of an improved product, it may capture a significant share of the collective market and significantly reduce the market for the reference product/reference listed drug, and thereby the potential size of the market for our therapeutic equivalent product candidates. In addition, the improved product may be protected by additional patent rights.

Additionally, competition in the pharmaceutical market is intense. Reference products/reference listed drugs face competition on numerous fronts as technological advances are made that may offer patients a more convenient form of administration or increased efficacy, or as new products are introduced. As new products are approved that compete with the reference product/reference listed drug for our therapeutic equivalent product candidates, such as Forteo, sales may be significantly and adversely impacted and may render the originator obsolete. If the market for the originator is impacted, we in turn may lose significant market share or market potential for our products and product candidates. As a result, the value of our product pipeline could be negatively impacted and our business, prospects and financial condition could suffer.

Our product candidates, if approved, will face significant competition from the reference products and from other therapeutic equivalent products of the reference products, and from other products. Our or our collaboration partners' failure to effectively compete may prevent us from achieving significant market penetration and expansion.

We and our collaboration partners expect to enter highly competitive pharmaceutical markets. Successful competitors in the pharmaceutical market have the ability to effectively discover, obtain patents, develop, test and obtain regulatory approvals for products, as well as the ability to effectively commercialize, market and promote approved products, including communicating the effectiveness, safety and value of products to consumers and medical professionals. Numerous companies, universities, and other research institutions are engaged in developing, patenting, manufacturing and marketing of products competitive with those that we are developing. For example, in April 2017, the FDA approved Radius Health's TYMLOS®, and Amgen and UCB are developing Evenity (romosozumab), which is expected to be approved by the FDA in the second half of 2019, each of which could potentially compete with PF708. Many of these potential competitors, such as Amgen Inc., Eli Lilly and Company, Teva Pharmaceutical Industries Limited, Emergent BioSolutions Inc., and Radius Health are large, experienced companies that enjoy significant competitive advantages, such as substantially greater financial, research and development, manufacturing, personnel and marketing resources. Recent and potential future merger and acquisition activity in the biotechnology and pharmaceutical industries is likely to result in even more resources being concentrated among a smaller number of our competitors. These companies also maintain greater brand recognition and more experience and expertise in undertaking preclinical testing and clinical trials of product candidates and obtaining the FDA and other regulatory approvals of products. Established pharmaceutical companies may also invest heavily to accelerate discovery and development of novel compounds that could make our product candidates obsolete.

In addition, our therapeutic equivalent and vaccine products may face competition from companies that develop and commercialize products that compete directly with our products. See *"Risks Related to Government Regulation—If other therapeutic equivalent or generic products to Forteo are approved and successfully commercialized before PF708, our business would suffer."*

Use of our product candidates could be associated with side effects or adverse events.

Use of our product candidates could be associated with side effects or adverse events which can vary in severity (from minor reactions to death) and frequency (infrequent or prevalent). Side effects or adverse events associated with the use of our product candidates may be observed at any time, including in clinical trials or when a product is commercialized, and any such side effects or adverse events may negatively affect our and our collaboration partners' ability to obtain and maintain regulatory approval or market our product candidates. Side effects such as toxicity or other safety issues associated with the use of our product candidates could require us or

our collaboration partners to perform additional studies or halt development or sale of these product candidates or expose us or our collaboration partners to product liability lawsuits which would harm our business. We or our collaboration partners may be required by regulatory agencies to conduct additional animal or human studies regarding the safety and efficacy of our product candidates which were not planned or anticipated. We or our collaborators may also be required to change our product labeling, including increasing the prominence and content of warnings and contraindications for our products. The FDA could require us or our collaboration partners to develop a Risk Evaluation and Mitigation Strategy (REMS) for such product or, if a REMS is already in place, to incorporate additional requirements under the REMS, and foreign regulatory authorities may require similar risk management strategies. There can be no assurance that we or our collaboration partners will resolve any issues related to any product-related adverse events to the satisfaction of the FDA or any regulatory agency in a timely manner or ever, which could harm our business, prospects and financial condition.

In addition, if we and our collaboration partners are successful in commercializing PF708, Px563L, RPA563 or any other product candidates, the FDA, European Medicines Agency (EMA), competent authorities of the Member States of the European Economic Area (EEA), and other foreign regulatory agency regulations require that the application holder timely report certain information about adverse medical events. We or our collaboration partners may fail to report adverse events we become aware of within the prescribed timeframe. We or our collaboration partners may also fail to appreciate that we or our collaboration partners have become aware of a reportable adverse event, especially if it is not reported to us as an adverse event or if it is an adverse event that is unexpected or removed in time from the use of our products. If we or our collaboration partners fail to comply with our reporting obligations, the FDA, the EMA, competent authorities of the Member States of the EEA, or other foreign regulatory agencies could take action including criminal prosecution, the imposition of civil monetary penalties, seizure of our products, or delay in approval or clearance of our products.

We currently rely on a limited number of third parties for a substantial portion of our revenue. The loss of or a change in any of these third parties, including its creditworthiness, could materially reduce our revenue and adversely impact our financial position.

Two third-parties accounted for more than 10% of our 2018 and 2017 revenue and one third party accounted for more than 10% of our 2016 revenue. Jazz and BARDA each accounted for more than 10% of our revenue in 2018 and 2017, and Pfizer accounted for more than 10% of our 2016 revenue. We have also entered into agreements with Alvogen and NT Pharma to develop and commercialize PF708. The prospects for PF708 depend on the expertise, development and commercial skills, and financial strength of Alvogen and NT Pharma.

In addition, in August 2016, we entered into a termination agreement with Pfizer pursuant to which our development and license agreement was terminated and all rights to PF582 returned to us. The termination accelerated recognition of $45.8 million of revenue that had been previously deferred, and we will not recognize any additional future revenue under this agreement. Pfizer will no longer be responsible for manufacturing, clinical studies and commercialization of PF582. We will not receive additional revenue from Pfizer.

The loss of any key collaboration partner or any significant adverse change in the size or terms of a contract with a key third party could significantly reduce our revenue over the short term. Moreover, having our revenue concentrated among a limited number of entities creates a concentration of financial risk for us, and in the event that any significant third party is unable to fulfill its payment obligations to us, our operating results and cash position would suffer. See *"Risks Relating to our Reliance on Third Parties—We are substantially dependent on the expertise of Alvogen, Jazz, and NT Pharma to develop and commercialize certain product candidates. If we fail to maintain our current strategic relationship with Alvogen, Jazz, our business, commercialization prospects and financial condition may be materially adversely affected.*"

We may fail to select or capitalize on the most scientifically, clinically or commercially promising or profitable product candidates.

We continue to evaluate our business strategy and, as a result, may modify our strategy in the future. In this regard, we may, from time to time, focus our product development efforts on different product candidates or may delay, suspend or terminate the future development of a product candidate at any time for strategic, business, financial or other reasons. For example, in 2017 we decided to pause development activities on PF582 and PF529 and focus development efforts elsewhere within the product portfolio while we continue to engage potential strategic partners for PF582 and PF529 to advance the programs and maximize value. As a result of changes in our strategy, we have and may in the future change or refocus our existing product development, commercialization and manufacturing strategies. This could require changes in our facilities and our personnel. Any product development changes that we implement may not be successful. In particular, we may fail to select or capitalize on the most scientifically, clinically or commercially promising or profitable product candidates. Our decisions to allocate our research and development, management and financial resources toward particular product candidates may not lead to the development of viable commercial products and may divert resources from better opportunities. Similarly, our decisions to delay or terminate product development programs may also prove to be incorrect and could cause us to miss valuable opportunities.

We currently have limited marketing capabilities and no sales organization.

We currently have limited sales and marketing capabilities. We have no prior experience in the marketing, sale and distribution of pharmaceutical products and there are significant risks involved in building and managing a sales organization, including our ability to hire, retain and incentivize qualified individuals, generate sufficient sales leads, provide adequate training to sales and marketing personnel and effectively manage a geographically dispersed sales and marketing team.

To commercialize PF708, we have entered into collaboration agreements with Alvogen and NT Pharma and the prospects for PF708 depend on the expertise, development and commercial skills, and financial strength of Alvogen and NT Pharma. Under the Alvogen agreements, Alvogen has the exclusive right to commercialize and manufacture PF708 in the United States, European Union, Middle East, North Africa, and the rest of the world not covered by the NT Pharma territory. Under the NT Pharma agreement, we granted an exclusive license to NT Pharma to commercialize PF708 in certain Asian countries and a non-exclusive license to conduct development activities in such territories with respect to PF708. For Px563L, RPA563, and our other product candidates, if approved, we will need to identify potential sales, marketing and distribution partners or establish our own internal sales force. In the future, we may choose to collaborate with other third parties that have direct sales forces and established distribution systems, either to augment our own sales force or in lieu of our own sales force. If we are unable to enter into such arrangements on acceptable terms or at all, we may not be able to successfully commercialize our product candidates. If we are not successful in commercializing our product candidates, either on our own or through collaborations with one or more third parties, our future product revenue will suffer and we would incur significant additional losses.

We enter into various contracts in the normal course of our business that periodically incorporate provisions whereby we indemnify the other party to the contract. In the event we would have to perform under these indemnification provisions, it could have a material adverse effect on our business, financial position and results of operations.

In the normal course of business, we periodically enter into academic, commercial and consulting agreements that contain indemnification provisions. With respect to our academic agreements, we may be required to indemnify the institution and related parties from losses arising from claims relating to the products, processes or services made, used, sold or performed pursuant to the agreements for which we have secured licenses, and from claims arising from our or our sublicensees' exercise of rights under the agreement. With respect to commercial agreements entered into with our protein production customers, we typically provide

indemnification for claims from third parties arising out of any potential intellectual property infringement associated with our *Pf*ēnex Expression Technology® in the course of performing our services. With respect to our commercial agreements, the bulk of which are with contract manufacturers, we indemnify our vendors from third-party product liability claims which result from the production, use or consumption of the product, as well as for certain alleged infringements of any patent or other intellectual property right by a third party. With respect to consultants, we indemnify them from claims arising from the good faith performance of their services. In all of the above cases, we do not indemnify the parties for claims resulting from the negligence or willful misconduct of the indemnified party.

In certain circumstances, we maintain insurance coverage which we believe may limit our obligations under certain of these indemnification provisions. However, we do not carry insurance for all risks that our business may encounter, including our obligations under certain indemnification provisions. To the extent we do not have insurance to cover certain indemnification obligations, we are denied insurance coverage, or our obligation under an indemnification provision exceeds applicable insurance coverage, any significant, uninsured liability may require us to pay substantial amounts, which would adversely affect our working capital and results of operations.

We may have difficulty expanding our operations successfully.

As we advance our product candidates through the development process, we will need to expand our development, regulatory, manufacturing, quality, sales and marketing capabilities or contract with other organizations to provide these capabilities for us. As our operations expand, we expect that we will need to manage additional relationships with various collaboration partners, suppliers and other organizations, including with respect to the commercialization of PF708, if PF708 receives regulatory approval.

As of December 31, 2018, we had 71 full-time employees, including a total of 14 employees who hold Ph.D. degrees. Our management and personnel, systems and facilities currently in place may not be adequate to support this future growth. Therefore, we will need to continue to expand our managerial, operational, finance and other resources to manage our operations and clinical trials, continue our development activities and commercialize our product candidates, if approved. In order to effectively execute our growth strategy, we will be required to:

- manage our clinical trials effectively;
- identify, recruit, retain, incentivize and integrate additional employees;
- establish and maintain collaborations with third parties for the development and commercialization of our product candidates, or otherwise build and maintain a sales, marketing and distribution infrastructure to commercialize any products for which we may obtain marketing approval;
- manage our internal development efforts effectively while carrying out our contractual obligations to third parties; and
- continue to improve our operational, financial and management controls, reporting systems and procedures.

Due to our limited financial resources and our limited experience in managing a company with such anticipated growth, we may not be able to effectively manage the expansion of our operations or recruit and train additional qualified personnel. In addition, this expansion of our operations may lead to significant costs and may divert our management and business development resources. Any inability to manage growth could delay the execution of our development and strategic objectives, or disrupt our operations, which could materially impact our business, revenue, and operating results.

The U.S. government holds certain intellectual property rights related to our Anthrax vaccines, Px563L and RPA563 and Malaria vaccine, Px533.

Although we have intellectual property related to expression of recombinant protective antigen in *P. fluorescens*, the U.S. government holds certain patents related to the recombinant protective antigen in Px563L and RPA563, as well as certain license rights to intellectual property related to other Px563L components used to produce the final vaccine, which, if exercised, could materially impact our business, revenue and operating results. We have rights to utilize this intellectual property held by the U.S. government by virtue of the Authorization and Consent clauses of our contracts with the U.S. government.

Our contracts with the U.S. government, and our subcontracts with U.S. government contractors, require ongoing funding decisions by the U.S. government; reduced or discontinued funding of these contracts could cause our financial condition and operating results to suffer materially.

Development of our anthrax vaccines, Px563L and RPA563, is funded by BARDA and development of our Px563L-SDI anthrax vaccine and our malaria vaccine, Px533, is funded by The National Institute of Allergy and Infectious Diseases (NIAID). The funding for government programs is subject to Congressional appropriations, often made on a fiscal year basis, even for programs designed to continue for several years. These appropriations can be subject to political considerations and stringent budgetary constraints. Additionally, our government-funded development contracts give the U.S. government the right, exercisable in its sole discretion, to extend this contract for successive options following a base period of performance. The value of the services to be performed during these options may constitute the majority of the total value of the underlying contract. If levels of government expenditures and authorizations for biodefense decrease or shift to programs in areas where we do not offer products or are not developing product candidates, or if the U.S. government otherwise declines to exercise its options under its contracts with us, our business, revenue and operating results would suffer.

Our current contract with BARDA is a cost-plus fixed fee contract and potential future contracts with the U.S. government may also be structured this way. Under our cost-plus fixed fee contracts, we are allowed to recover our approved costs plus a fixed fee. The total price on a cost-plus fixed fee contract is based primarily on allowable costs incurred, but generally is subject to contract funding limitations. U.S. government regulations require us to notify our customer of any cost overruns or underruns on a cost-plus fixed fee contract. If we incur costs in excess of the funding limitation specified in the contract, we may not be able to recover those cost overruns.

Moreover, changes in U.S. government contracting policies could directly affect our financial performance. Factors that could materially adversely affect our U.S. government contracting business include:

- budgetary constraints affecting U.S. government spending generally, or specific departments or agencies in particular;
- changes in U.S. government fiscal policies or available funding;
- changes in U.S. government defense and homeland security priorities;
- changes in U.S. government programs or requirements;
- adoption of new laws or regulations;
- technological developments;
- U.S. government shutdowns, threatened shutdowns or budget delays;
- competition and consolidation in our industry; and
- general economic conditions.

These or other factors could cause U.S. government departments or agencies to reduce their development funding or future purchases under contracts, to exercise their right to terminate contracts or fail to exercise their

options to extend our contracts, any of which could have a material adverse effect on our business, financial condition, operating results and ability to meet our financial obligations.

Unfavorable provisions in government contracts, some of which are customary, may subject our business to material limitations, restrictions and uncertainties and may have a material adverse impact on our financial condition and operating results.

Government contracts contain provisions that give the U.S. government substantial rights and remedies, many of which are not typically found in commercial contracts, including provisions that allow the U.S. government to:

- terminate existing contracts, in whole or in part, for any reason or no reason;
- unilaterally reduce or modify the government's obligations under such contracts or subcontracts, without the contractor's consent, including by imposing equitable price adjustments;
- audit contract-related costs and fees, including allocated indirect costs;
- claim rights, including intellectual property rights, in products and data developed under such agreements;
- under certain circumstances involving public health and safety, license inventions made under such agreements to third parties;
- suspend the contractor from receiving new contracts pending resolution of alleged violations of procurement laws or regulations;
- impose U.S. manufacturing requirements for products that embody inventions conceived or first reduced to practice under such contracts;
- suspend or debar the contractor from doing future business with the government;
- decline to exercise an option to continue a contract;
- exercise an option to purchase only the minimum amount, if any, specified in a contract;
- decline to exercise an option to purchase the maximum amount, if any, specified in a contract;
- claim rights to facilities or to products, including intellectual property, developed under the contract;
- require repayment of contract funds spent on construction of facilities in the event of contract default;
- take actions that result in a longer development timeline than expected;
- change the course of a development program in a manner that differs from the contract's original terms or from our desired development plan, including decisions regarding our partners in the program;
- pursue civil or criminal remedies under the False Claims Act (FCA) and False Statements Act; and
- control or prohibit the export of products.

Generally, government contracts, including our contract with BARDA, contain provisions permitting unilateral termination or modification, in whole or in part, at the U.S. government's convenience. Under general principles of government contracting law, if the U.S. government terminates a contract for convenience, the government contractor may recover only its incurred or committed costs, settlement expenses and profit on work completed prior to the termination. If the U.S. government terminates a contract for default, the government contractor is entitled to recover costs incurred and associated profits on accepted items only and may be liable for excess costs incurred by the government in procuring undelivered items from another source. In addition, government contracts normally contain additional requirements that may increase our costs of doing business,

reduce our profits, and expose us to liability for failure to comply with these terms and conditions. These requirements include, for example:

- specialized accounting systems unique to government contracts;
- mandatory financial audits and potential liability for price adjustments or recoupment of government funds after such funds have been spent;
- public disclosures of certain contract information, which may enable competitors to gain insights into our research program;
- mandatory internal control systems and policies; and
- mandatory socioeconomic compliance requirements, including labor standards, non-discrimination and affirmative action programs and environmental compliance requirements.

If we fail to maintain compliance with these requirements, we may be subject to potential contract or FCA liability and to termination of our contracts.

Furthermore, we are required to enter into agreements and subcontracts with third parties, including suppliers, consultants and other third-party contractors in order to satisfy our contractual obligations pursuant to our agreements with the United States government. Negotiating and entering into such arrangements can be time-consuming and we may not be able to reach agreement with such third parties. Any such agreement must also be compliant with the terms of our government contract. Any delay or inability to enter into such arrangements or entering into such arrangements in a manner that is non-compliant with the terms of our contract, may result in violations of our contract.

We may not have the right to prohibit the U.S. government from using certain technologies developed by us, and we may not be able to prohibit third-party companies, including our competitors, from using those technologies in providing products and services to the U.S. government. The U.S. government generally takes the position that it has the right to royalty-free use of technologies that are developed under U.S. government contracts.

Most U.S. government contracts grant the U.S. government the right to use on a royalty free basis, for or on behalf of the U.S. government, any technologies developed and data first produced by the contractor under the government contract. If we were to develop technology under a contract with such a provision, we might not be able to prohibit third parties, including our competitors, from using that technology in providing products and services to the U.S. government.

Our business is subject to audit by the U.S. government and a negative audit could adversely affect our business.

U.S. government agencies such as the Department of Health and Human Services (HHS) and the Defense Contract Audit Agency (DCAA) routinely audit and investigate government contractors and recipients of federal grants and contracts. These agencies review a contractor's performance under its contracts, cost structure and compliance with applicable laws, regulations and standards.

The HHS and the DCAA also review the adequacy of, and a contractor's compliance with, its internal control systems and policies, including the contractor's accounting, purchasing, property, estimating, compensation and management information systems. Any costs found to be improperly allocated to a specific contract will not be reimbursed, while such costs already reimbursed must be refunded. If an audit uncovers improper or illegal activities, we may be subject to civil and criminal penalties and administrative sanctions, including:

- termination of contracts;

- forfeiture of profits;
- suspension of payments;
- fines; and
- suspension or prohibition from conducting business with the U.S. government.

In addition, we could suffer serious reputational harm if allegations of impropriety were made against us, which could cause our stock price to decrease.

The United States government's determination to award a future contract may be challenged by an interested party, such as another bidder, at the United States Government Accountability Office (GAO) or in federal court. If such a challenge is successful, any future contract we may be awarded may be terminated.

The laws and regulations governing the procurement of goods and services by the U.S. government provide procedures by which other bidders and interested parties may challenge the award of a government contract. If we are awarded a government contract, such challenges or protests could be filed even if there are not any valid legal grounds on which to base the protest. If any such protests are filed, the government agency may decide to suspend our performance under the contract while such protests are being considered by the GAO or the applicable federal court, thus potentially delaying delivery of payment. In addition, we could be forced to expend considerable funds to defend any potential award. If a protest is successful, the government may be ordered to terminate the contract and resolicit proposals. The government agencies with which we have contracts could even be directed to award a potential contract to one of the other bidders.

Laws and regulations affecting government contracts make it more costly and difficult for us to successfully conduct our business.

We must comply with numerous laws and regulations relating to the formation, administration and performance of government contracts, which can make it more difficult for us to retain our rights under our government contracts, including our contract with BARDA. These laws and regulations affect how we conduct business with government agencies. Among the most significant government contracting regulations that affect our business are:

- the Federal Acquisition Regulations (FAR) and agency-specific regulations supplemental to the FAR, which comprehensively regulate the procurement, formation, administration and performance of government contracts;
- the Truth in Negotiations Act, which requires certification and disclosure of cost or pricing data in connection with contract negotiations;
- business ethics and public integrity obligations, which govern conflicts of interest and the hiring of former government employees, restrict the granting of gratuities and funding of lobbying activities and include other requirements such as the Anti-Kickback Statute and Foreign Corrupt Practices Act;
- export and import control laws and regulations; and
- laws, regulations and executive orders restricting the use and dissemination of information classified for national security purposes and the exportation of certain products and technical data.

Any material changes in applicable laws and regulations could restrict our ability to maintain our existing BARDA contract and obtain new contracts, which could limit our ability to conduct our business and materially adversely affect our results of operations.

If product liability lawsuits are brought against us, we may incur substantial liabilities and may be required to limit commercialization of products we develop.

We face a risk of product liability as a result of the clinical testing of our product candidates and will face an even greater risk if we commercialize any products. For example, we may incur liability if any product we develop allegedly causes injury or is found to be otherwise unsuitable during product testing, manufacturing, marketing or sale. Any such product liability claims may include allegations of defects in manufacturing, defects in design, a failure to warn of dangers inherent in the product, negligence, strict liability and a breach of warranties. Claims could also be asserted under state consumer protection acts. If we cannot successfully defend ourselves against product liability claims, we may incur substantial liabilities or be required to limit commercialization of our products. Regardless of the merits or eventual outcome, liability claims may result in:

- decreased demand for PF708, Px563L, RPA563 or any other product candidates or products we develop;
- injury to our reputation and significant negative media attention;
- withdrawal of clinical trial participants or cancellation of clinical trials;
- costs to defend the related litigation;
- a diversion of management's time and our resources;
- substantial monetary awards to trial participants or patients;
- regulatory investigations, product recalls, withdrawals or labeling, marketing or promotional restrictions;
- loss of revenue; and
- the inability to commercialize any products we develop.

Our inability to obtain and maintain sufficient product liability insurance at an acceptable cost and scope of coverage to protect against potential product liability claims could impact the commercialization of PF708, Px563L, RPA563 and any other products we develop. We currently carry product liability insurance covering our clinical trials in the amount of $10.0 million in the aggregate. Although we maintain such insurance, any claim that may be brought against us could result in a court judgment or settlement that is in excess of the limits of our insurance coverage. Our insurance policies also have various exclusions and deductibles, and we may be subject to a product liability claim for which we have no coverage. We will have to pay any amounts awarded by a court or negotiated in a settlement that exceed our coverage limitations or that are not covered by our insurance, and we may not have, or be able to obtain, sufficient capital to pay such amounts. Moreover, in the future, we may not be able to maintain insurance coverage at a reasonable cost or in sufficient amounts to protect us against losses. If and when we obtain approval for marketing PF708, Px563L, RPA563 or any other product candidates, we intend to expand our insurance coverage to include the sale of such products; however, we may be unable to obtain this liability insurance on commercially reasonable terms.

Our employees, independent contractors, principal investigators, CROs, CMOs, consultants and collaboration partners may engage in misconduct or other improper activities, including noncompliance with regulatory standards and requirements and insider trading.

We are exposed to the risk that our employees, independent contractors, principal investigators, third-party clinical research organizations (CROs) and contract manufacturing organizations (CMOs), consultants and collaboration partners may engage in fraudulent conduct or other illegal activity. Misconduct by these parties could include intentional, reckless and/or negligent conduct or unauthorized activities that violate: (1) regulations of the FDA and comparable foreign authorities, including those laws requiring the reporting of true, complete and accurate information to such authorities; (2) manufacturing standards; (3) federal and state healthcare fraud and abuse laws and regulations; or (4) laws that require the reporting of true and accurate financial information

and data. In particular, sales, marketing and business arrangements in the healthcare industry are subject to extensive laws and regulations intended to prevent fraud, misconduct, kickbacks, self-dealing and other abusive practices. These laws and regulations may restrict or prohibit a wide range of pricing, discounting, marketing and promotion, sales commission, customer incentive programs and other business arrangements. These activities also include the improper use of information obtained in the course of clinical trials, which could result in regulatory sanctions and serious harm to our reputation. We have adopted a Code of Ethics and Conduct, but it is not always possible to identify and deter misconduct by employees and other third parties, and the precautions we take to detect and prevent this activity may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from governmental investigations or other actions or lawsuits stemming from a failure to be in compliance with such laws or regulations. If any such actions are instituted against us, and we are not successful in defending ourselves or asserting our rights, those actions could have a significant impact on our business including the imposition of significant civil, criminal and administrative penalties, damages, monetary fines, possible exclusion from participation in Medicare, Medicaid and other federal healthcare programs, contractual damages, reputational harm, diminished profits and future earnings, and curtailment of our operations, any of which could adversely affect our ability to operate our business and our results of operations.

Our cash and cash equivalents and short-term investments could be adversely affected if the financial institutions in which we hold our cash and cash equivalents and short-term investments fail.

We regularly maintain cash balances at third-party financial institutions in excess of the Federal Deposit Insurance Corporation (FDIC) insurance limit. While we monitor the cash balances in our accounts and adjust the balances as appropriate, these balances could be impacted, and there could be a material adverse effect on our business, if one or more of the financial institutions with which we deposit fails or is subject to other adverse conditions in the financial or credit markets. To date, we have experienced no loss or lack of access to our invested cash or cash equivalents; however, we can provide no assurance that access to our invested cash and cash equivalents will not be impacted by adverse conditions in the financial and credit markets.

We may be subject to information technology failures, including data protection breaches and cyber-attacks, that could disrupt our operations, damage our reputation and adversely affect our business, operations, and financial results.

We rely on our information technology systems for the effective operation of our business and for the secure maintenance and storage of confidential data relating to our business and third-party businesses. Although we have implemented security controls to protect our information technology systems, experienced programmers or hackers may be able to penetrate our security controls, and develop and deploy viruses, worms and other malicious software programs that compromise our confidential information or that of third parties and cause a disruption or failure of our information technology systems. Any such compromise of our information technology systems could result in the unauthorized publication of our confidential business or proprietary information, result in the unauthorized release of customer, supplier or employee data, result in a violation of privacy or other laws, expose us to a risk of litigation, or damage our reputation. The cost and operational consequences of implementing further data protection measures either as a response to specific breaches or as a result of evolving risks, could be significant. In addition, our inability to use or access our information systems at critical points in time could adversely affect the timely and efficient operation of our business. Any delayed sales, significant costs or lost customers resulting from these technology failures could adversely affect our business, operations and financial results.

Third parties with which we conduct business have access to certain portions of our sensitive data. In the event that these third parties do not properly safeguard our data that they hold, security breaches could result and negatively impact our business, operations and financial results.

Our business involves the use of hazardous materials and we, our collaboration partners, and our third-party manufacturers and suppliers must comply with environmental laws and regulations, which can be expensive and restrict how we do business.

Our research and development and manufacturing activities and our third-party manufacturers' and suppliers' activities involve the controlled storage, use and disposal of hazardous materials owned by us, including small quantities of acetonitrile, methanol, ethanol, ethidium bromide and compressed gases, and other hazardous compounds. We and our collaboration partners, manufacturers and suppliers are subject to laws and regulations governing the use, manufacture, storage, handling and disposal of these hazardous materials. In some cases, these hazardous materials and various wastes resulting from their use are stored at our and our manufacturers' facilities pending their use and disposal. We cannot eliminate the risk of contamination, which could cause an interruption of our commercialization efforts, research and development efforts and business operations, environmental damage resulting in costly clean-up and liabilities under applicable laws and regulations governing the use, storage, handling and disposal of these materials and specified waste products.

Although we believe that the safety procedures utilized by us and our third-party manufacturers for handling and disposing of these materials generally comply with the standards prescribed by these laws and regulations, we cannot guarantee that this is the case or eliminate the risk of accidental contamination or injury from these materials. In such an event, we may be held liable for any resulting damages and such liability could exceed our resources and state or federal or other applicable authorities may curtail our use of certain materials and interrupt our business operations.

We are also subject to numerous environmental, health and workplace safety laws and regulations, including those governing laboratory procedures, and the handling of biohazardous materials. Although we maintain workers' compensation insurance to cover us for costs and expenses we may incur due to injuries to our employees resulting from the use of these materials, this insurance may not provide adequate coverage against potential liabilities. For claims not covered by workers' compensation insurance, we also maintain an employer's liability insurance policy in the amount of $1.0 million per occurrence and in the aggregate. We do not maintain insurance for environmental liability or toxic tort claims that may be asserted against us.

Environmental laws and regulations are complex, change frequently and have tended to become more stringent. We cannot predict the impact of such changes and cannot be certain of our future compliance. Any inability to comply with environmental laws and regulations may adversely affect our business and operating results.

Changes in accounting principles, or interpretations thereof, could have a significant impact on our financial position and results of operations.

We prepare our consolidated financial statements in accordance with accounting principles generally accepted in the United States of America, referred to as GAAP. These principles are subject to interpretation by the Securities and Exchange Commission (SEC) and various bodies formed to interpret and create appropriate accounting principles. A change in these principles can have a significant effect on our reported results and may even retroactively affect previously reported transactions. Additionally, the adoption of new or revised accounting principles may require that we make significant changes to our systems, processes and controls.

It is not clear if or when these potential changes in accounting principles may become effective, whether we have the proper systems and controls in place to accommodate such changes and the impact that any such changes may have on our financial position and results of operations.

Even if PF708, Px563L, RPA563 or any of our other product candidates obtain regulatory approval, they may never achieve market acceptance or commercial success.

Even if we obtain FDA or other regulatory approvals, PF708, Px563L, RPA563 or any of our other product candidates may not achieve market acceptance among physicians and patients and may not be commercially

successful. The degree and rate of market acceptance of PF708, Px563L, RPA563 or any of our other product candidates for which we receive approval depends on a number of factors, including:

- the performance of our collaboration partners, including Alvogen, Jazz, and NT Pharma;
- the safety and efficacy of the product as demonstrated in clinical trials;
- the clinical indications for which the product is approved;
- acceptance by physicians, major operators of clinics and patients of the product as a safe and effective treatment;
- proper training and administration of our products by physicians and medical staff;
- the potential and perceived advantages of our products over alternative treatments;
- the cost of treatment in relation to alternative treatments and willingness to pay for our products, if approved, on the part of physicians and patients;
- relative convenience and ease of administration;
- the prevalence and severity of adverse events; and
- the effectiveness of our sales and marketing efforts.

Any failure by our product candidates that obtain regulatory approval to achieve market acceptance or commercial success would materially adversely affect our results of operations and delay, prevent or limit our ability to generate revenue and continue our business.

Risks Relating to our Reliance on Third Parties

We rely on Alvogen, our collaboration partners, and other third parties, and in some cases a single third party, to manufacture commercial, nonclinical and clinical supplies of our product candidates, supply key materials to manufacture our product candidates, and to store critical components of our product candidates for us. Our business could be harmed if those third parties fail to provide us with sufficient quantities of product candidates, or fail to do so at acceptable quality levels or prices.

We do not currently have the infrastructure or capability internally to manufacture supplies of our product candidates for use in clinical studies, and we lack the resources and the capability to manufacture any of our product candidates on a clinical or commercial scale. We rely on Alvogen, our collaboration partners, and other third-party manufacturers, including with respect to PF708, to manufacture our product candidates for preclinical and clinical studies, and potential commercial supply. Successfully transferring complicated manufacturing techniques to manufacturing organizations and scaling up these techniques for commercial quantities will be time consuming and we may not be able to achieve such transfer. For example, we are currently transferring manufacturing techniques related to PF708 to Alvogen. Moreover, the market for contract manufacturing services for protein therapeutics is highly cyclical, with periods of relatively abundant capacity alternating with periods in which there is little available capacity. If our need for contract manufacturing services increases during a period of industry-wide production capacity shortage, we may not be able to produce our product candidates on a timely basis or on commercially viable terms. Although we generally do not begin a clinical study unless we believe we have a sufficient supply of a product candidate to complete such study, any significant delay or discontinuation in the supply of a product candidate for an ongoing clinical study due to the need to replace a third-party manufacturer could considerably delay completion of our clinical studies, product testing, and potential regulatory approval of our product candidates, which could harm our business and results of operations.

Reliance on Alvogen, our collaboration partners, and other third-party manufacturers entails additional risks, including reliance on the third party for regulatory compliance and quality assurance, the possible breach of the manufacturing agreement by the third party, and the possible termination or nonrenewal of the agreement by

the third party at a time that is costly or inconvenient for us. In addition, Alvogen, our collaboration partners, and other third-party manufacturers may not be able to comply with cGMP, or similar regulatory requirements outside the United States. Our failure, or the failure of Alvogen, our collaboration partners, or other third-party manufacturers, to comply with applicable regulations could result in sanctions being imposed on us, including fines, injunctions, civil penalties, delays, suspension or withdrawal of approvals, license revocation, seizures or recalls of products, operating restrictions, untitled or warning letters, suspension of ongoing clinical trials, refusal to approve pending applications or supplemental applications, and criminal prosecutions, any of which could significantly and adversely affect supplies of our product candidates or any other product candidates or products that we may develop. Any failure or refusal to supply the components for our product candidates that are being developed could delay, prevent or impair clinical development or commercialization efforts. If our manufacturers were to breach or terminate their manufacturing arrangements with us, the development or commercialization of the affected products or product candidates could be delayed, which could have an adverse effect on our business. Any change in our manufacturers could be costly because the commercial terms of any new arrangement could be less favorable and because the expenses relating to the transfer of necessary technology and processes could be significant.

If PF708 or any of our other product candidates are approved, in order to produce the quantities necessary to meet anticipated market demand, Alvogen or any manufacturer that we and our collaboration partners engage may need to increase manufacturing capacity. If we, Alvogen, our collaboration partners, or our manufacturers are unable to produce PF708 or any of our product candidates in sufficient quantities to meet the requirements for the launch of these products or to meet future demand, our revenue and gross margins could be adversely affected. Although we currently believe that we, Alvogen, our collaboration partners, and our manufacturers will not have any material supply issues, we cannot be certain that we will be able to obtain long-term supply arrangements for PF708 or any of our other product candidates or materials used to produce such product candidate on acceptable terms, if at all. If we, Alvogen, or our collaboration partners are unable to arrange for manufacturing, either through a third party or Alvogen, or to do so on commercially reasonable terms, we may not be able to complete development of or market PF708 or any of our other product candidates.

Any significant disruption in our supplier relationships could harm our business. We source key materials from third parties, either directly through agreements with suppliers or indirectly through our manufacturers who have agreements with suppliers. There are a small number of suppliers for certain capital equipment and key materials that are used to manufacture our product candidates. Such suppliers may not sell these key materials to our manufacturers at the times we need them or on commercially reasonable terms. We do not have any control over the process or timing of the acquisition of these key materials by our manufacturers. Any significant delay in the supply of a product candidate or its key materials for an ongoing clinical study could considerably delay completion of our clinical studies, product testing and potential regulatory approval of our product candidate. If Alvogen, our manufacturers, collaboration partners, or we are unable to purchase these key materials for our product candidates after regulatory approval, the commercial launch of our product candidates could be delayed or there could be a shortage in supply, which would impair our ability to generate revenues from the sale of our product candidates.

We also rely on third parties to store master and working cell banks for our product candidates. We have master and working cell banks and believe we would have adequate backup should any cell bank be lost in a catastrophic event. However, it is possible that we could lose multiple cell banks and have our manufacturing severely impacted by the need to replace the cell banks, which could materially and adversely affect our business, financial condition and results of operations.

We have no experience manufacturing our product candidates on a large clinical or commercial scale and have no manufacturing facility. We are dependent on Alvogen for the manufacture and supply of PF708.

We do not own or operate facilities for the manufacture of any of our product candidates, including PF708. We currently have no plans to build our own clinical or commercial scale manufacturing capabilities. For PF708,

we currently rely on Alvogen to manufacture PF708. To meet our projected increased needs for supplies of our product candidates to support our activities through regulatory approval and commercial manufacturing, Alvogen and the CMOs with whom we currently work will need to increase the scale of production. In addition, the CMO on which we principally rely has limited experience manufacturing products on a commercial scale.

Reliance on Alvogen and third-party manufacturers entails risks to which we would not be subject if we manufactured product candidates or products ourselves, including reliance on Alvogen or the third-party for regulatory compliance and quality assurance, the possibility of breach of the manufacturing agreement by Alvogen or the third-party because of factors beyond our control, including a failure to manufacture any products we may eventually commercialize in accordance with our specifications, and the possibility of termination or nonrenewal of the agreement by the third-party, based on its own business priorities, at a time that is costly or damaging to us. In addition, the FDA and other regulatory authorities require that any products that we may eventually commercialize be manufactured according to cGMPs and similar foreign standards. Any failure by Alvogen or our third-party manufacturers to comply with cGMPs or failure to scale up manufacturing processes, including any failure to deliver sufficient quantities of product candidates in a timely manner, could lead to delay in, or failure to obtain, regulatory approval of our product candidates. In addition, failure to comply with cGMPs could be the basis for the FDA to issue a warning letter, withdraw approvals for product candidates previously granted to us, or take other regulatory or legal action, including recall or seizure of outside supplies of the product candidate, total or partial suspension of production, suspension of on-going clinical trials, refusal to approve pending applications or supplemental applications, detention of product, refusal to permit the import or export of products, injunction, or imposing civil and criminal penalties.

If we receive FDA approval for PF708, Alvogen will be obligated to use diligent efforts to continue to develop, manufacture and commercialize PF708 in the United States at Alvogen's cost and expense. Before PF708 can be approved, the manufacturing facilities for both the active pharmaceutical ingredient, or API, and finished pharmaceutical product, will be inspected by the FDA for compliance with cGMPs. If Alvogen or the third-party manufacturers fail to pass these preapproval inspections, our NDA will not be approved or will be significantly delayed until compliance can be demonstrated. We and Alvogen have not yet identified alternate suppliers for PF708, nor have we identified alternate suppliers for any other product candidate, in the event the current CMOs we utilize are unable to scale to commercial production, pass required preapproval inspections, or if we otherwise experience any problems with them. Although we believe alternative third-party suppliers with the necessary manufacturing and regulatory expertise and facilities exist, it would be expensive and take a significant amount of time to arrange for, and qualify, alternative suppliers. Furthermore, if we or Alvogen are required to identify, qualify and contract with new manufacturing suppliers of PF708, we and Alvogen would need to demonstrate to the satisfaction of the FDA in a bridging study that any new supply of PF708 is substantially the same as the PF708 used in our clinical trials. Any bridging study may require further clinical testing, including testing in patients. We cannot assure you that we can arrange for alternative third-party manufacturing sources for PF708, or any other product candidate, on commercially reasonable terms or in a timely manner, or that such manufacturers will be capable of manufacturing PF708, or any other product candidate, in compliance with cGMPs and to FDA's satisfaction.

Any significant disruption in our supplier relationships could harm our business. Any significant delay in the supply of a product candidate or its key materials for an ongoing clinical study could considerably delay completion of our clinical studies, product testing and potential regulatory approval of our product candidates. If Alvogen, our manufacturers or we are unable to purchase these key materials after regulatory approval has been obtained for PF708 or our other product candidates, the commercial launch of PF708 or our other product candidates would be delayed or there would be a shortage in supply, which would impair our ability to generate revenues from the sale of PF708 or our other product candidates.

We are substantially dependent on the expertise of Alvogen, Jazz, and NT Pharma to develop and commercialize certain product candidates. If we fail to maintain our current strategic relationship with Alvogen, Jazz, NT Pharma, or with any future collaboration partner, our business, commercialization prospects and financial condition may be materially adversely affected.

Because we have limited or no capabilities for late-stage product development, manufacturing, sales, marketing and distribution, we may need to enter into alliances with other companies to develop our product candidates. For example, to commercialize PF708, we have entered into collaboration agreements with Alvogen and NT Pharma and the prospects for PF708 depend in part on the expertise, development and commercial skills, and financial strength of Alvogen and NT Pharma. Under the Alvogen agreement, Alvogen has the exclusive right to commercialize and manufacture PF708 in the United States, European Union, Middle East, North Africa, and the rest of the world not covered by the NT Pharma agreement. Under the NT Pharma agreement, we granted an exclusive license to NT Pharma to commercialize PF708 in certain Asian countries and a non-exclusive license to conduct development activities in such territories with respect to PF708. In addition, we entered into an agreement with Jazz, pursuant to which we have transferred the development, manufacturing and commercialization of certain product candidates.

In February 2015, we entered into a development and license agreement with Pfizer to develop and commercialize PF582. In August 2016, we entered into a termination agreement with Pfizer pursuant to which the development and license agreement was terminated and all rights to PF582 have been returned to us. The termination accelerated recognition of $45.8 million of revenue that had been previously deferred and we will not recognize any additional future revenue under the Pfizer development and license agreement. Following our strategic review in November 2017, we decided to pause our development activities for PF582 and focus our efforts and resources elsewhere in our product portfolio. While we are seeking a new collaboration partner for the development and commercialization of PF582, there are no assurances that we will find a new collaboration partner or that the terms and timing of any such arrangements would be acceptable to us.

In July 2016, we entered into a license and option agreement with Jazz, pursuant to which we and Jazz are collaboratively developing hematology/oncology products, including PF743, a recombinant crisantaspase, and PF745, a recombinant crisantaspase with half-life extension technology, and Jazz has the exclusive right to manufacture and commercialize such products throughout the world. In December 2017, we amended the agreement. We may be eligible to receive additional payments under the amended agreement of up to $188.5 million based on achievement of certain research and development, regulatory and sales-related milestones, bringing the total value of payments and potential payments associated with the collaboration to $224.5 million. In addition, we may be eligible to receive tiered royalties on worldwide sales of any products resulting from the collaboration at rates reduced from those under the 2016 agreement.

The prospects for the product candidates developed under this collaboration depend on the expertise, development and commercial skills, and financial strength of Alvogen, Jazz, and NT Pharma. Our collaborations with Alvogen, Jazz, NT Pharma or any future collaboration partner may not be successful, and we may not realize the expected benefits from such collaborations, due to a number of important factors, including but not limited to the following:

- Alvogen, Jazz, NT Pharma, or any future collaboration partner may terminate their agreements with us prior to completing development or commercialization of the product candidates under the collaboration, in whole or in part, adversely impacting the potential approval and our revenue from licensed products;
- the timing and amount of any payments we may receive under these agreements will depend on, among other things, the efforts, allocation of resources, and successful commercialization of the relevant product candidates by Alvogen, Jazz, NT Pharma, or any future collaboration partner, as applicable, under our agreements;
- the timing and amounts of expense reimbursement that we may receive are uncertain; or

- Alvogen, Jazz, NT Pharma, or any future collaboration partner may change the focus of their development or commercialization efforts or pursue or emphasize higher priority programs.

A failure of Alvogen, Jazz, NT Pharma or any future collaboration partner to successfully develop our product candidates which are covered by the collaboration, or commercialize such product candidates, or the termination of our agreements with Alvogen, Jazz, NT Pharma, or any future collaboration partner, as applicable, may have a material adverse effect on our business, results of operations and financial condition.

Our existing product development and/or commercialization arrangements, and any that we may enter into in the future, may not be successful, which could adversely affect our ability to develop and commercialize our product candidates.

We are a party to, and continue to seek additional, collaboration arrangements with other pharmaceutical companies for the development and/or commercialization of our current and future product candidates. In such alliances, we would expect our collaboration partners to provide substantial capabilities in clinical development, manufacturing, regulatory affairs, sales and marketing, both in the United States and internationally. For example, to commercialize PF708, we have entered into collaboration agreements with Alvogen and NT Pharma and the prospects for PF708 depend in part on the expertise, development and commercial skills, and financial strength of Alvogen and NT Pharma. Under the Alvogen agreement, Alvogen has the exclusive right to commercialize and manufacture PF708 in the United States, European Union, Middle East, North Africa, and the rest of the world not covered by the NT Pharma agreement. Under the NT Pharma agreement, we granted an exclusive license to NT Pharma to commercialize PF708 in certain Asian countries and a non-exclusive license to conduct development activities in such territories with respect to PF708.

To the extent that we decide to enter into additional collaboration agreements, we will face significant competition in seeking appropriate collaboration partners. Any failure to meet our clinical milestones with respect to an unpartnered product candidate would make finding a collaboration partner more difficult. Moreover, collaboration arrangements are complex and time consuming to negotiate, document and implement, and we cannot guarantee that we can successfully maintain such relationships or that the terms of such arrangements will be favorable to us. If we fail to maintain, establish and implement collaboration or other alternative arrangements, the value of our business and operating results will be adversely affected.

We may not be successful in our efforts to establish, implement and maintain collaborations or other alternative arrangements if we choose to enter into such arrangements. The terms of any collaboration or other arrangements that we may establish may not be favorable to us. The management of collaborations may take significant time and resources that distract our management from other matters. Our ability to successfully collaborate with any current or future collaboration partners may be impaired by multiple factors including:

- a collaboration partner may shift its priorities and resources away from our programs due to a change in business strategies, or a merger, acquisition, sale or downsizing of its company or business unit;
- a collaboration partner may cease development in therapeutic areas which are the subject of alliances with us;
- a collaboration partner may change the success criteria for a particular program or product candidate thereby delaying or ceasing development of such program or candidate;
- a significant delay in initiation of certain development activities by a collaboration partner will also delay payments tied to such activities, thereby impacting our ability to fund our own activities;
- a collaboration partner could develop a product that competes, either directly or indirectly, with our current or future products, if any;
- a collaboration partner with commercialization obligations may not commit sufficient financial or human resources to the marketing, distribution or sale of a product;

- a collaboration partner with manufacturing responsibilities may encounter regulatory, resource or quality issues and be unable to meet demand requirements;
- a collaboration partner may exercise its rights under the agreement to terminate our collaboration;
- a dispute may arise between us and a collaboration partner concerning the research or development of a product candidate or commercialization of a product resulting in a delay in milestones, royalty payments or termination of a program and possibly resulting in costly litigation or arbitration which may divert management attention and resources;
- the results of our clinical trials may not match our collaboration partners' expectations, even if statistically significant;
- a collaboration partner may not adequately protect or enforce the intellectual property rights associated with a product or product candidate; and
- a collaboration partner may use our proprietary information or intellectual property in such a way as to invite litigation from a third party.

Any such activities by our current or future collaboration partners could adversely affect us financially and could harm our business reputation.

In addition to product development and commercialization capabilities, we may depend on our alliances with other companies to provide substantial additional funding for development and potential commercialization of our product candidates. We may not be able to obtain funding on favorable terms from these alliances, and if we are not successful in doing so, we may not have sufficient funds to develop a particular product candidate internally, or to bring product candidates to market. Failure to bring our product candidates to market will prevent us from generating sales revenue, and this may substantially harm our business. Furthermore, any delay in entering into these alliances could delay the development and commercialization of our product candidates and reduce their competitiveness even if they reach the market. As a result, our business and operating results may be adversely affected.

We rely on CROs to conduct and oversee our planned clinical trials for our product candidates and other clinical trials for product candidates we are developing or may develop in the future. If our CROs do not successfully carry out their contractual duties, meet expected deadlines, or otherwise conduct the trials as required or comply with regulatory requirements, or if our relationship with our CRO terminates, we and our collaboration partners may not be able to seek or obtain regulatory approval for or commercialize our product candidates when expected or at all, and our business could be substantially harmed.

We will continue to rely upon medical institutions, clinical investigators and contract laboratories to conduct our trials in accordance with our clinical protocols and in accordance with applicable legal and regulatory requirements. These third parties play a significant role in the conduct of these trials and the subsequent collection and analysis of data from the clinical trials. These third parties are not our employees, and except for remedies available to us under our agreements with such third parties, there is no guarantee that any such third party will devote adequate time and resources to our clinical trial. If our CRO or any other third parties upon which we rely for administration and conduct of our clinical trials do not successfully carry out their contractual duties or obligations or meet expected deadlines, if they need to be replaced or if the quality or accuracy of the clinical data they obtain is compromised due to the failure to adhere to our clinical protocols, regulatory requirements, or for other reasons, or if they otherwise perform in a substandard manner, our clinical trials may be extended, delayed, suspended or terminated, and we may not be able to complete development of, seek or obtain regulatory approval for, or successfully commercialize our product candidates. We plan to rely heavily on these third parties for the execution of clinical trials for products we are developing or may develop in the future, and will control only certain aspects of their activities. Nevertheless, we are responsible for ensuring that each of our clinical trials is conducted in accordance with the applicable protocol, legal, regulatory and scientific standards, and our reliance on our CRO does not relieve us of our regulatory responsibilities.

We, our CRO and our collaboration partners are required to comply with Good Clinical Practice (GCP), which are regulations and guidelines enforced by regulatory authorities around the world for products in clinical development. Regulatory authorities enforce these GCP regulations through periodic inspections of clinical trial sponsors, principal investigators and clinical trial sites. If we, our CRO or our collaboration partners fail to comply with applicable GCP regulations, the clinical data generated in clinical trials may be deemed unreliable and submission of marketing applications may be delayed or the regulatory authorities may require us to perform additional clinical trials before accepting our applications for review or approving marketing applications. We cannot assure that, upon inspection, a regulatory authority will determine that any of our clinical trials comply or complied with applicable GCP regulations. In addition, clinical trials must be conducted with product produced under current Good Manufacturing Practices (cGMP) regulations, which are enforced by regulatory authorities. Any failure to comply with these regulations may require us to repeat clinical trials, which would delay the regulatory approval process. Moreover, our business may be implicated if our CRO violates federal or state fraud and abuse or false claims laws and regulations or healthcare privacy and security laws.

Comparative clinical trials require a substantial number of patients that can form the basis for generating statistically significant results. Delays in site initiation or unexpectedly low patient enrollment rates may delay the results of the clinical trial. CROs may also generate higher costs than anticipated. As a result, our results of operations and the commercial prospects for our product candidates would be harmed, our costs could increase, and our ability to generate revenue could be delayed. Further, if our relationship with our CRO is terminated, we may be unable to enter into arrangements with an alternative CRO on commercially reasonable terms, or at all. Switching or adding CROs can involve substantial cost and require extensive management time and focus. In addition, there is a natural transition period when a new CRO commences work. As a result, delays may occur, which can materially impact our ability to meet our desired clinical development timelines. Although we carefully manage our relationship with our CROs, there can be no assurance that we will not encounter such challenges or delays in the future or that these delays or challenges will not have a material adverse impact on our business, prospects, financial condition or results of operations.

We rely on third-party suppliers, and in some instances a single third-party supplier, for the manufacture and supply of certain materials in our protein production services, and these suppliers could cease to manufacture the materials, go out of business or otherwise not perform as anticipated.

We rely on third-party suppliers for our protein production services and in some instances a single third-party supplier, for the manufacture and supply of certain materials. We currently rely, and expect to continue to rely, on a single-source supplier for the manufacture and supply of CRM197. To meet these demands, our supplier is in the process of increasing production capacity, and we also have established a repository in the United States that is capable of storing a safety stock of CRM197 and the CRM197 cell bank. Furthermore, we have taken steps to identify alternate sources of supply sufficient to support future needs; however, there may be delays in switching to these alternative suppliers if our contract with primary sources are terminated without notice. Regardless of the foregoing alternative measures, we cannot guarantee that we will have an adequate supply of CRM197. If we are unable to secure adequate quantities of CRM197 from our primary supplier, from potential secondary suppliers or from our safety stock, we may be required to identify additional suppliers. If we are required to engage additional suppliers, we may not be able to enter into an alternative supply arrangement on commercially reasonable terms, or at all. Even if we are able to identify additional suppliers and enter into agreements on commercially reasonable terms, we may incur delays associated with identifying and qualifying additional suppliers and negotiating the terms of any supply contracts. These delays could adversely impact our business and negatively affect profitability of our protein production services.

We have entered into collaborations with third parties in connection with the development of certain of our product candidates. Even if we believe that the development of our technology and product candidates is promising, our partners may choose not to proceed with such development.

Our existing agreements with our collaboration partners, Alvogen, Jazz, and NT Pharma, and any future collaboration agreements we may enter into, are generally subject to termination by the counterparty on short

notice upon the occurrence of certain circumstances. Accordingly, even if we believe that the development of product candidates is worth pursuing, our partners may choose not to continue with such development. If any of our collaborations are terminated, such as the termination of our collaboration with Pfizer in August 2016, we may be required to devote additional resources to the development of our product candidates or seek a new collaboration partner on short notice, and the terms of any additional collaboration or other arrangements that we establish may not be favorable to us.

We are also at risk that our current and any potential collaborations or other arrangements may not be successful. Factors that may affect the success of our collaborations include the following:

- our collaboration partners may incur financial and cash flow difficulties that force them to limit or reduce their participation in our joint projects;
- our collaboration partners may be pursuing alternative technologies or developing alternative products that are competitive to our technology and products, either on their own or in partnership with others;
- our collaboration partners may terminate their collaboration with us, which could make it difficult for us to attract new partners or adversely affect perception of us in the business and financial communities; and
- our collaboration partners may pursue higher priority programs or change the focus of their development programs, which could affect their commitment to us.

If we cannot maintain successful collaborations, our business, financial condition and operating results may be adversely affected.

If we are unable to maintain our commercial supply agreements with key customers purchasing CRM197, sales revenue could decline.

We primarily sell CRM197 directly to biopharmaceutical companies and currently have several supply agreements in place for supply of CRM197. To establish and maintain relationships with customers, we believe we need to maintain adequate supplies of CRM197, remain price competitive, comply with regulatory regulations and provide high quality products. If we are unable to establish and maintain arrangements for the sale of CRM197, our revenue and profits would decline.

Risks Relating to Our Intellectual Property

Our collaboration partners and other third parties may assert ownership or commercial rights to inventions we develop from our use of the materials which they provide to us, or otherwise arising from our collaboration.

We collaborate with other companies and institutions with respect to research and development matters. Also, we rely on numerous third parties to provide us with materials that we use to develop our technology. If we cannot successfully negotiate sufficient ownership, licensing and/or commercial rights to any inventions that result from our use of any third-party collaborator's materials, or if disputes arise with respect to the intellectual property developed with the use of a collaborator's materials, or data developed in a collaborator's study, our ability to capitalize on the market potential of these inventions or developments may be limited or precluded altogether.

If our efforts to protect our intellectual property related to our platform technology and our current or future product candidates are not adequate, we may not be able to compete effectively in our market.

We rely upon a combination of patents, trade secret protection and confidentiality agreements to protect the intellectual property related to our current product candidates and our development programs. If we do not adequately protect our intellectual property, competitors may be able to use our technologies and erode or negate

any competitive advantage we may have, which could harm our business and ability to achieve profitability. In particular, our success depends in large part on our ability to obtain and maintain patent protection in the United States and other countries with respect to our platform and product candidates. However, we may not be able to file and prosecute all necessary or desirable patent applications at a reasonable cost or in a timely manner. We may also fail to identify patentable aspects of our research and development before it is too late to obtain patent protection. Any disclosure to or misappropriation by third parties of our confidential proprietary information could enable competitors to quickly duplicate or surpass our technological achievements, eroding our competitive position in our market.

The patentability of inventions, and the validity, enforceability and scope of patents in the biotechnology and pharmaceutical industry involve complex legal and scientific questions and can be uncertain. This uncertainty includes changes to the patent laws through either legislative action to change statutory patent law or court action that may reinterpret existing law in ways affecting the scope or validity of issued patents. The patent applications that we own or license may fail to result in issued patents in the United States or foreign countries. There is a substantial amount of prior art in the biotechnology and pharmaceutical fields, including scientific publications, patents and patent applications. Our ability to obtain and maintain valid and enforceable patents depends on whether the differences between our technology and the prior art allow our technology to be patentable over the prior art. We may be unaware of certain prior art relating to our patent applications and patents, which could prevent a patent from issuing from a pending patent application or result in an issued patent being invalidated. Even if the patents do successfully issue, third parties may challenge the validity, enforceability or scope of such issued patents or any other issued patents we own or license, which may result in such patents being narrowed, invalidated or held unenforceable.

Patents granted by the European Patent Office may be opposed by any person within nine months from the publication of their grant and, in addition, may be challenged before national courts at any time. Furthermore, even if they are unchallenged, our patents and patent applications may not adequately protect our intellectual property or prevent others from designing around our claims. If the breadth or strength of protection provided by the patents and patent applications we hold, license or pursue with respect to our product candidates is threatened, it could threaten our ability to commercialize our product candidates. In addition, recent changes to the patent laws of the United States provide additional procedures for third parties to challenge the validity of issued patents based on patent applications filed after March 15, 2013. If the breadth or strength of protection provided by the patents and patent applications we hold or pursue with respect to our current or future product candidates is challenged, then it could threaten our ability to commercialize our current or future product candidates and could threaten our ability to prevent competitive products from being marketed. Further, if we encounter delays in our clinical trials, the period of time during which we could market our current or future product candidates under patent protection would be reduced. Since patent applications in the United States and most other countries are confidential for a period of time after filing, we cannot be certain that we were the first to either (i) file any patent application related to our product candidates, or (ii) invent any of the inventions claimed in our patents or patent applications. Furthermore, for applications filed before March 16, 2013, or patents issuing from such applications, an interference proceeding can be provoked by a third party or instituted by the United States Patent and Trademark Office (USPTO), to determine who was the first to invent any of the subject matter covered by the patent claims of our applications and patents. As of March 16, 2013, the United States transitioned to a “first-to-file” system for deciding which party should be granted a patent when two or more patent applications are filed by different parties claiming the same invention. A third party that files a patent application in the USPTO before us could therefore be awarded a patent covering an invention of ours even if we had made the invention before it was made by the third party. The change to “first-to-file” from “first-to-invent” is one of the changes to the patent laws of the United States resulting from the Leahy-Smith America Invents Act (Leahy-Smith Act) signed into law on September 16, 2011. Among some of the other significant changes to the patent laws are changes that limit where a patentee may file a patent infringement suit and provide opportunities for third parties to challenge any issued patent in the USPTO. It is not yet clear what, if any, impact the Leahy-Smith Act will have on the operation of our business. However, the Leahy-Smith Act and its implementation could increase the uncertainties and costs surrounding the prosecution of our patent

applications and the enforcement or defense of our issued patents, all of which could have a material adverse effect on our business and financial condition.

Even where laws provide protection, costly and time-consuming litigation could be necessary to enforce and determine the scope of our proprietary rights, and the outcome of such litigation would be uncertain. Moreover, any actions we may bring to enforce our intellectual property against our competitors could provoke them to bring counterclaims against us, and some of our competitors have substantially greater intellectual property portfolios than we have.

Even if PF708 is approved by the FDA or the EMA we may be delayed in selling PF708 due to direct or indirect legal challenges.

Even if PF708 receives marketing approval in the U.S. or the EU, we may also be subject to direct legal challenges from Eli Lilly and Company, the manufacturer of Forteo, and we could be delayed or prevented from launching PF708 as a result of court orders, regulatory stays, or the time necessary to resolve such challenges. For instance, we are aware of at least one recent instance of a third party being subject to litigation initiated by Eli Lilly and Company on a product purporting to be a generic version of Eli Lilly's Forteo (teriparatide [rDNA origin] injection) product. Similarly, we may be subject to indirect legal challenges in the U.S. as a result of new executive orders from the President of the United States or the amendment or reversal of various laws by the U.S. Congress that govern or impact the approval of products being developed pursuant to the 505(b)(2) pathway, including the Hatch-Waxman Act, which in aggregate may cause a delay in or prevent the approval or commercial launch of PF708.

If we are unable to protect the confidentiality of our trade secrets, the value of our technology could be materially adversely affected and our business would be harmed.

In addition to the protection afforded by patents, we also rely on trade secret protection and confidentiality agreements to protect proprietary know-how that may not be patentable, processes for which patents may be difficult to obtain or enforce and any other elements of our product development processes that involve proprietary know-how, information or technology that is not covered by patents.

As part of our efforts to protect our trade secrets and other confidential information, we require our employees, consultants, collaborators and advisors to execute confidentiality agreements upon the commencement of their relationships with us. These agreements require that all confidential information developed by the individual or made known to the individual by us during the course of the individual's relationship with us be kept confidential and not disclosed to third parties. These agreements, however, may not provide us with adequate protection against improper use or disclosure of confidential information, and these agreements may be breached. Adequate remedies may not exist in the event of unauthorized use or disclosure of our confidential information. We also note in this respect that trade secret protection in foreign countries may not provide protection to the same extent as federal and state laws in the United States. A breach of confidentiality could significantly affect our competitive position. In addition, in some situations, these agreements may conflict with, or be subject to, the rights of third parties with whom our employees, consultants, collaborators or advisors have previous employment or consulting relationships. To the extent that our employees, consultants or contractors use any intellectual property owned by others in their work for us, disputes may arise as to the rights in any related or resulting know-how and inventions. Also, third parties, including our competitors, may independently develop substantially equivalent proprietary information and technologies or otherwise lawfully gain access to our trade secrets and other confidential information. In such a case, we would have no right to prevent such third parties from using such proprietary information or technologies to compete with us, which could harm our competitive position.

If we infringe or are alleged to infringe intellectual property rights of third parties, our business could be harmed.

Our research, development and commercialization activities may infringe or otherwise violate or be claimed to infringe or otherwise violate patents owned or controlled by other parties. Our competitors have developed large portfolios of patents and patent applications in fields relating to our business and it may not always be clear to industry participants, including us, which patents cover various types of products or methods of use. There may also be patent applications that have been filed but not published that, when issued as patents, could be asserted against us. The coverage of patents is subject to interpretation by the courts, and the interpretation is not always uniform. If we are sued for patent infringement, we would need to demonstrate that our product candidates, products or methods either do not infringe the patent claims of the relevant patent or that the patent claims are invalid, and we may not be able to do this. Proving that a patent is invalid is difficult. For example, in the United States, proving invalidity requires a showing of clear and convincing evidence to overcome the presumption of validity enjoyed by issued patents. Also in proceedings before courts in Europe, the burden of proving invalidity of the patent usually rests on the party alleging invalidity. Third parties could bring claims against us that would cause us to incur substantial expenses and, if successful against us, could cause us to pay substantial damages. Further, if a patent infringement suit were brought against us, we could be forced to stop or delay research, development, manufacturing or sales of the product or product candidate that is the subject of the suit.

As a result of patent infringement claims, or to avoid potential claims, we may choose or be required to seek licenses from third parties. These licenses may not be available on acceptable terms, or at all. Even if we are able to obtain a license, the license would likely obligate us to pay license fees or royalties or both, and the rights granted to us might be nonexclusive, which could result in our competitors gaining access to the same intellectual property. Ultimately, we could be prevented from commercializing a product, or be forced to cease some aspect of our business operations, if, as a result of actual or threatened patent infringement claims, we are unable to enter into licenses on acceptable terms.

There has been substantial litigation and other proceedings regarding patent and other intellectual property rights in the pharmaceutical industry. In addition to infringement claims against us, we may become a party to other patent litigation and other proceedings, including interference, derivation or post-grant proceedings declared or granted by the USPTO and similar proceedings in foreign countries, regarding intellectual property rights with respect to our current or future products. Third parties may submit applications for patent term extensions in the United States and/or supplementary protection certificates in the EU member States seeking to extend certain patent protection which, if approved, may interfere with or delay the launch of one or more of our biosimilar or vaccine products. The cost to us of any patent litigation or other proceeding, even if resolved in our favor, could be substantial. Some of our competitors may be able to sustain the costs of such litigation or proceedings more effectively than we can because of their substantially greater financial resources. Patent litigation and other proceedings may also absorb significant management time. Uncertainties resulting from the initiation and continuation of patent litigation or other proceedings could impair our ability to compete in the marketplace. The occurrence of any of the foregoing could have a material adverse effect on our business, financial condition or results of operations. We may become involved in lawsuits to protect or enforce our inventions, patents or other intellectual property or the patents of our licensors, which could be expensive and time consuming.

Competitors may infringe our intellectual property, including our patents or the patents of our licensors. In addition, one or more of our third-party collaborators may have submitted, or may in the future submit, a patent application to the USPTO without naming a lawful inventor that developed the subject matter in whole or in part while under an obligation to execute an assignment of rights to us. As a result, we may be required to file infringement or inventorship claims to stop third-party infringement, unauthorized use, or to correct inventorship. This can be expensive, particularly for a company of our size, and time-consuming. Any claims that we assert against perceived infringers could also provoke these parties to assert counterclaims against us alleging that we

infringe their intellectual property rights. In addition, in an infringement proceeding, a court may decide that a patent of ours is not valid or is unenforceable, or may refuse to stop the other party from using the technology at issue on the grounds that our patent claims do not cover its technology or that the factors necessary to grant an injunction against an infringer are not satisfied.

An adverse determination of any litigation or other proceedings could put one or more of our patents at risk of being invalidated, held unenforceable or interpreted narrowly and could put our patent applications at risk of not issuing.

Interference, derivation or other proceedings brought at the USPTO or any foreign patent authority may be necessary to determine the priority or patentability of inventions with respect to our patent applications or those of our licensors or collaborators. Litigation or USPTO proceedings brought by us may fail. An unfavorable outcome in any such proceedings could require us to cease using the related technology or to attempt to license rights to it from the prevailing party, or could cause us to lose valuable intellectual property rights. Our business could be harmed if the prevailing party does not offer us a license on commercially reasonable terms, if any license is offered at all. Even if we are successful, domestic or foreign litigation or USPTO or foreign patent office proceedings may result in substantial costs and distraction to our management. We may not be able, alone or with our licensors or collaborators, to prevent misappropriation of our trade secrets, confidential information or proprietary rights, particularly in countries where the laws may not protect such rights as fully as in the United States.

Furthermore, because of the substantial amount of discovery required in connection with intellectual property litigation or other proceedings, there is a risk that some of our confidential information could be compromised by disclosure during this type of litigation or proceedings. In addition, during the course of this kind of litigation or proceedings, there could be public announcements of the results of hearings, motions or other interim proceedings or developments or public access to related documents. If investors perceive these results to be negative, the market price for our common stock could be significantly harmed.

We may not be able to globally protect our intellectual property rights.

Filing, prosecuting and defending patents on product candidates in all countries throughout the world would be prohibitively expensive, and our intellectual property rights in some countries outside the United States can be less extensive than those in the United States. In addition, the laws of some foreign countries do not protect intellectual property rights to the same extent as federal and state laws in the United States and in some cases, may even force us to grant a compulsory license to competitors or other third parties. Consequently, we may not be able to prevent third parties from practicing our inventions in all countries outside the United States, or from selling or importing products made using our inventions in and into the United States or other jurisdictions. Competitors may use our technologies in jurisdictions where we have not obtained patent protection to develop their own products and further, may export otherwise infringing products to territories where we have patent protection, but enforcement is not as strong as that in the United States. These products may compete with our products and our patents or other intellectual property rights may not be effective or sufficient to prevent them from competing.

Many companies have encountered significant problems in protecting and defending intellectual property rights in foreign jurisdictions. The legal systems of certain countries, particularly certain developing countries, do not favor the enforcement of patents and other intellectual property protection, particularly those relating to biopharmaceuticals, which could make it difficult for us to stop the infringement of our patents or marketing of competing products in violation of our proprietary rights generally. Proceedings to enforce our patent rights in foreign jurisdictions could result in substantial costs and divert our efforts and attention from other aspects of our business, could put our patents at risk of being invalidated or interpreted narrowly and our patent applications at risk of not issuing and could provoke third parties to assert claims against us. We may not prevail in any lawsuits that we initiate and the damages or other remedies awarded, if any, may not be commercially meaningful.

Accordingly, our efforts to enforce our intellectual property rights around the world may be inadequate to obtain a significant commercial advantage from the intellectual property that we develop or license.

In addition, our ability to protect and enforce our intellectual property rights may be adversely affected by unforeseen changes in domestic and foreign intellectual property laws.

Obtaining and maintaining patent protection depends on compliance with various procedural, document submission, fee payment and other requirements imposed by governmental patent agencies, and our patent protection could be reduced or eliminated for non-compliance with these requirements.

Periodic maintenance fees, renewal fees, annuity fees and various other governmental fees on patents and/or applications will be due to be paid to the USPTO and various governmental patent agencies outside of the United States in several stages over the lifetime of the patents and/or applications. The USPTO and various non-U.S. governmental patent agencies require compliance with a number of procedural, documentary, fee payment and other similar provisions during the patent application process. In many cases, an inadvertent lapse can be cured by payment of a late fee or by other means in accordance with the applicable rules. However, there are situations in which noncompliance can result in abandonment or lapse of the patent or patent application, resulting in partial or complete loss of patent rights in the relevant jurisdiction. In such an event, our competitors might be able to use our technologies and this circumstance would have a material adverse effect on our business.

We may be subject to claims that our employees or consultants have wrongfully used or disclosed alleged trade secrets of former or other employers.

Many of our employees and consultants, including our senior management, have been employed or retained by other biotechnology or pharmaceutical companies, including our competitors or potential competitors. Although we try to ensure that our employees and consultants do not use the proprietary information or know-how of others in their work for us, we may be subject to claims that we or these employees or consultants have used or disclosed intellectual property, including trade secrets or other proprietary information, of any such employee's or consultant's former or other employer. We are not aware of any material threatened or pending claims related to these matters, but in the future litigation may be necessary to defend against such claims. If we fail in 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 defending against such claims, litigation could result in substantial costs and be a distraction to management.

Risks Related to Government Regulation

The approval processes of the FDA, EMA, and comparable foreign authorities are lengthy, time consuming and inherently unpredictable, and if we and our collaborators are ultimately unable to obtain regulatory approval for our product candidates, our business will be substantially harmed.

The research, development, testing, manufacturing, labeling, packaging, approval, promotion, advertising, storage, marketing, distribution, post-approval monitoring and reporting, and export and import of drug and biologic products are subject to extensive regulation by the FDA and other regulatory authorities in the United States, by the EMA and Competent Authorities of the Member States of the EEA, and by other regulatory authorities in other countries, which regulations differ from country to country. Neither we nor any collaboration partner is permitted to market PF708, Px563L, RPA563 or any other product candidates in the United States until approval from the FDA is received, or in the EEA until we receive European Commission authorization or approval from one or more Competent Authorities of the Member States of the EEA, as applicable. The time required to obtain approval from regulatory authorities is unpredictable, typically takes many years following the commencement of clinical trials, and depends upon numerous factors, including the substantial discretion of such regulatory authorities. In addition, approval policies, regulations, or the type and amount of clinical data

necessary to gain approval may change during the course of a product candidate's clinical development and may vary among jurisdictions, which may cause delays in the filing of an application and/or the approval or the decision not to approve an application. We and our collaboration partners have not submitted any market application to regulatory authorities or obtained regulatory approval for any product candidate and it is possible that none of our existing product candidates or any product candidates we may seek to develop in the future will ever obtain regulatory approval.

Applications for our product candidates could fail to receive regulatory approval or their regulatory approval could be delayed for many reasons, including but not limited to the following:

- the data collected from clinical studies of our product candidates may not be sufficient to support the submission of a Biologics License Application (BLA) under the section 351(a) pathway of the PHSA; an NDA under the section 505(b)(2) of the Food, Drug, and Cosmetic Act; a BLA for a biosimilar product application under the section 351(k) pathway of the PHSA, a marketing authorization under Article 6 of Regulations (EC) No. 726/2004 and/or Article 8(3), 10(1), 10(3) or 10a of Directive 2001/83/EC in the EEA, a biosimilar marketing authorization under Article 6 of Regulation (EC) No. 726/2004 and/or Article 10(4) of Directive 2001/83/EC in the EEA, or other submission or to obtain regulatory approval in the United States, the EEA, or elsewhere;
- regulatory authorities may disagree with the design (including the duration) or implementation of our clinical trials and may, at any time, determine that the regulatory pathway that we have committed to for PF708, Px563L, RPA563 or any other product candidate is inappropriate;
- the population studied in the clinical program may not be sufficiently broad or representative to assure efficacy and safety in the full population for which we seek approval;
- regulatory authorities may disagree with our interpretation of data from preclinical studies or clinical trials;
- we may be unable to demonstrate to the satisfaction of regulatory authorities that a product candidate's risk-benefit ratio for its proposed indication is acceptable;
- regulatory authorities may fail to approve the manufacturing processes, test procedures and specifications, or facilities of third-party manufacturers with whom we contract for clinical and commercial supplies; and
- the approval policies or regulations of regulatory authorities may significantly change in a manner that renders our clinical data insufficient for approval.

This lengthy approval process as well as the unpredictability of future clinical trial results may result in our failing to seek or obtain regulatory approval to market PF708, Px563L, RPA563 or any other product candidates, which would significantly harm our business, results of operations and prospects. Moreover, any delays in the commencement or completion of clinical testing could significantly impact our product development costs and could result in the need for additional financing.

Our most advanced product development program is PF708. The top-line results announced in May 2018 of our Study PF708-301, which we have submitted to FDA in support of our application for regulatory approval, showed comparable overall profiles between PF708 and Forteo after 24 weeks of daily injection in osteoporosis patients. The primary end point for Study PF708-301 is anti-drug anti-body formation after 24 weeks of drug treatment. The secondary end points are changes in bone mineral density and bone turnover markers after 24 weeks of drug treatment, as well as PK parameters for up to 4 hours after the first dose. FDA has indicated that if the outcome of the immunogenicity primary end point is not sufficiently positive, 12-month data bone mineral density data may be necessary to support regulatory approval of PF708, which would add time, expense, and uncertainty to the development of PF708. We cannot provide assurances that immunogenicity data generated in Study 708-301, even if successful, will not require us to generate additional bone mineral density data to support the submission or approval of an NDA, or that submission of such additional data will ultimately result in approval.

In addition, even if we or our collaboration partners were to obtain approval, regulatory authorities may approve any of our product candidates for fewer or more limited indications than requested, may grant approval contingent on the performance of costly post-marketing clinical trials, or may approve a product candidate with a label that does not include the labeling claims necessary or desirable for the successful commercialization of that product candidate. Any of the foregoing scenarios could materially harm the commercial prospects for our product candidates.

If we fail to obtain approval for our most advanced product candidates or if our most advanced product candidates are not commercially successful, we may have to curtail our product development programs and our business would be materially harmed.

We have invested a significant portion of our time, financial resources and efforts in the development of our most advanced product candidates, including PF708, Px563L and RPA563. The clinical and commercial success of our product candidates will depend on a number of factors, including the following:

- timely and successful completion of all necessary clinical trials, which may be significantly slower or cost more than we currently anticipate and will depend substantially upon the accurate and satisfactory performance of third-party contractors;
- our ability to find suitable collaboration partners to develop our product candidates or our ability to obtain substantial additional sources of funding to develop our product candidates;
- timely receipt of necessary marketing approvals from the FDA, the European Commission, and similar foreign regulatory authorities;
- maintaining an acceptable safety and adverse event profile of our products following approval;
- achieving and maintaining compliance with all regulatory requirements applicable to our product candidates or any approved products;
- making arrangements with third-party manufacturers for, or establishing, commercial manufacturing capabilities;
- launching commercial sales of our products, if and when approved, whether alone or in collaboration with others;
- obtaining and maintaining patent and trade secret protection and regulatory exclusivity, where available, for our product candidates;
- the availability, perceived advantages, relative cost, relative safety and relative efficacy of alternative and competing treatments;
- acceptance of our products, if and when approved, by patients, the medical community and third-party payors; and
- the ability to raise additional capital on acceptable terms to achieve our goals.

If we and our collaboration partners are unable to seek and obtain regulatory approval for any of our product candidates in a timely manner or at all, we may never realize revenue from these products and we may have to curtail our other product development programs. As a result, our business, financial condition and results of operations would be materially harmed.

Our ability to market our therapeutic equivalent products in the United States may be significantly delayed or prevented by the Hatch-Waxman patent dispute resolution mechanism, including a potential automatic 30-month stay of regulatory approval of our marketing applications.

Under Section 505(b)(2) of the FFDCA a pharmaceutical manufacturer may file an NDA that relies on studies not conducted by the applicant and for which the applicant has not obtained a right of reference as part of

the data demonstrating the product's safety and effectiveness. Often, this is done by relying on FDA's previous approval of a product to which the proposed drug is similar (but for which there are differences that preclude an ANDA). Among other things, this kind of reliance, avoids unnecessary duplication of studies already performed on a previously approved ("reference" or "listed") drug. We are pursuing a Section 505(b)(2) regulatory strategy for our PF708 product candidate and our NDA references Forteo (teriparatide), marketed by Eli Lilly for the treatment of osteoporosis, as our listed drug. It is possible that for one reason or another, we will not be able to establish that our PF708 product candidate is suitable for approval under the Section 505(b)(2) framework. In addition, to the extent we rely on certain data and information that was submitted to the FDA related to the safety of Forteo, the FDA will likely require any approved labeling for PF708 to include certain safety information that is included in the Forteo label, including contraindications, warnings, precautions and other safety information.

In addition, in the 505(b)(2) NDA for PF708 a Paragraph IV certification with regard to one of the patents listed in the Orange Book for Forteo. If within 45 days of the Paragraph IV notice, a lawsuit is filed alleging patent infringement, the FDA is prohibited from approving the 505(b)(2) NDA for 30 months (or a shorter period if the patent expires or there are certain settlements or judicial decisions in the patent litigation). It is possible that litigation will not be brought, or if brought will be resolved in less than 30 months, but if we are sued and the case is not resolved, we could face a delay in the launch of PF708, if it is approved. Additionally, non-patent exclusivity provisions under the FFDCA, such as NCE exclusivity, can delay the submission or the approval of a 505(b)(2) application or an ANDA. However, we do not expect that PF708 will be subject to such exclusivity as all relevant exclusivity periods for the listed drug, Forteo, have expired.

Clinical drug development involves a lengthy and expensive process with an uncertain outcome, and results of earlier studies and trials may not be predictive of future trial results.

Clinical testing is expensive and can take many years to complete, and its outcome is inherently uncertain. Furthermore, we rely on our collaboration partners, CROs, and clinical trial sites to ensure the proper and timely conduct of our clinical trials for our product candidates. While we have agreements governing the committed activities of our collaboration partners and CROs, we have limited influence over their actual performance. A failure of one or more clinical trials can occur at any time during the trial process. The results of preclinical studies and early clinical trials of our product candidates may not be predictive of the results of later-stage clinical trials. Product candidates that have shown promising results in early studies may still suffer significant setbacks in subsequent clinical studies. For example, the results generated to date in the clinical trial for PF708 do not ensure that later clinical trials will demonstrate similar results. There is a high failure rate for drugs and biologics proceeding through clinical studies, and product candidates in later stages of clinical trials may fail to show the desired safety and efficacy despite having progressed through preclinical studies and initial clinical trials. A number of companies in the biopharmaceutical industry have suffered significant setbacks in advanced clinical trials due to lack of efficacy or adverse safety profiles, notwithstanding promising results in earlier clinical trials, and we cannot be certain that we will not face similar setbacks. Even if the clinical trials for our product candidates are completed, nonclinical and clinical data are often susceptible to varying interpretations and analyses, and the results may not be sufficient to obtain regulatory approval for our product candidates.

We have in the past and may in the future experience delays in ongoing clinical trials for our product candidates, and we do not know whether future clinical trials, if any, will begin on time, need to be redesigned, enroll an adequate number of patients on time or be completed on schedule, if at all. The commencement or completion of clinical trials can be delayed or aborted for a variety of reasons, including delay or failure to:

- generate sufficient preclinical, toxicology, or other in vivo or in vitro data to support the initiation of human clinical studies;
- raise sufficient capital to fund a trial;
- obtain regulatory approval, or feedback on trial design, necessary to commence a trial;
- identify, recruit and train suitable clinical investigators;

- reach agreement on acceptable terms with prospective CROs and clinical trial sites, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs and trial sites;
- obtain institutional review board (IRB) approval or Ethics Committee (EC) positive opinion, as applicable at each site;
- identify, recruit, and enroll suitable patients to participate in a trial;
- have patients complete a trial or return for post-treatment follow-up;
- ensure clinical sites observe trial protocol or continue to participate in a trial;
- address any patient safety concerns that arise during the course of a trial;
- address any conflicts with new or existing laws or regulations;
- add a sufficient number of clinical trial sites;
- manufacture sufficient quantities of product candidate for use in clinical trials; and
- avoid delays in manufacturing, testing, releasing, validating, or importing/exporting sufficient stable quantities of our product candidates for use in clinical studies, or the inability to do any of the foregoing.

Patient enrollment is a significant factor in the completion of clinical trials and is affected by many factors, including the size and nature of the patient population, the proximity of patients to clinical sites, the eligibility criteria for the trial, the design of the clinical trial, competing clinical trials and clinicians' and patients' perceptions as to the potential advantages of the drug being studied in relation to other available therapies, including any new drugs or treatments that may be approved for the indications we are investigating.

We could also encounter delays if a clinical trial is suspended or terminated by us, by the IRBs or the ECs of the institutions in which such trials are being conducted, by the data safety monitoring board, for such trial or by the FDA or other regulatory authorities. Such authorities may suspend or terminate a clinical trial due to a number of factors, including failure to conduct the clinical trial in accordance with regulatory requirements or our clinical protocols, inspection of the clinical trial operations or trial site by the FDA or other regulatory authorities resulting in the imposition of a clinical hold, unforeseen safety issues or adverse side effects, failure to demonstrate a benefit from using a drug, changes in governmental regulations or administrative actions or lack of adequate funding to continue the clinical trial.

If we or our collaboration partners experience delays in the completion of, or termination of, any clinical trial of our product candidates, the commercial prospects of our product candidates may be harmed, and our ability to generate product revenue from any of these product candidates will be delayed. In addition, any delays in completing clinical trials for our product candidates will increase our costs, slow down our product candidate development and approval process and jeopardize our ability to commence product sales and generate revenue. Any of these occurrences may significantly harm our business, financial condition and prospects. In addition, many of the factors that cause, or lead to, a delay in the commencement or completion of clinical trials may also ultimately lead to the denial of regulatory approval of our product candidates.

The development, manufacture and commercialization of therapeutic equivalent and vaccine products pose unique risks, and our failure to successfully introduce therapeutic equivalent and vaccine products could have a negative impact on our business and future operating results.

We are actively working to develop multiple therapeutic equivalent products and vaccines, including our most advanced product candidates, PF708, Px563L, and RPA563. The cost to develop each biosimilar, proposed therapeutic equivalent drug, and vaccine product candidate could vary significantly and is highly dependent on

the specific compound and the amount and type of clinical work that will be necessary for regulatory approval. There can be no assurance that our clinical work will be successful, or that regulatory authorities will not require additional clinical development beyond that which we have planned. Additionally, we may enter into alliances and collaborations to fund biosimilar and therapeutic equivalent product research and development activities, and the success of any such biosimilar or therapeutic equivalent product program may depend on our ability to realize the benefits under such arrangements. Due to events beyond our control or the risks identified herein, we may be unable to fund all or some of our internal biosimilar, therapeutic equivalent, and vaccine product research and development initiatives, which would have an adverse impact on our strategy and growth initiatives.

We intend to pursue marketing authorization globally when commercially appropriate.

We may rely on the Animal Rule in conducting trials, which could be time consuming and expensive.

To obtain FDA approval for our vaccine candidates Px563L and/or RPA563, we may rely to some extent on adequate safety, and efficacy data from adequate and well-controlled animal studies conducted pursuant to regulations issued by the FDA in 2002, often referred to as the "Animal Rule" And related FDA guidance.

Because the FDA must agree among other things that data derived from animal studies establish that the product is reasonably likely to produce clinical benefit in humans, seeking approval under the Animal Rule may add significant time, complexity and uncertainty to the testing and approval process. The FDA may decide that our data are insufficient for approval and require additional preclinical, clinical or other studies, refuse to approve Px563L and/or RPA563, or place restrictions on our ability to commercialize the products. In addition, products approved under the Animal Rule are subject to additional requirements including post-marketing study requirements, restrictions to ensure safe use (if needed), and labeling requirements to inform patients that the drug's approval was based on efficacy studies conducted in animals alone.

Additionally, few facilities in the U.S. and internationally may have the capability to test animals involving exposure to anthrax or otherwise assist us in qualifying the requisite animal models, and we must compete with other companies for access to this limited pool of highly specialized resources. We therefore may not be able to secure contracts to conduct the testing in a predictable timeframe or at all.

If the FDA allows generic versions of Forteo to be approved under the ANDA regulatory pathway, PF708 may face additional competition.

PF708, similar to Forteo, is made recombinantly using living cells. In October 2017, however, the FDA issued a draft guidance document that identified standards by which chemically manufactured, or synthetic, versions of Forteo may be approved under the 505(j), or Abbreviated New Drug Application (ANDA), regulatory pathway, which would not require the conduct of a comparative clinical trial in patients for approval of the product. In addition, the FDA has rejected two citizen petitions that sought to prohibit approval of an ANDA for a synthetic version of Forteo. The availability of the ANDA regulatory pathway for synthetic versions of Forteo may result in additional competition for PF708. Additionally, products approved under the ANDA pathway are considered generic drugs, and generally are approved as therapeutic equivalents to the reference product, and therefore may be automatically substituted for the reference listed drug, depending on health care statutes and policies within each of the 50 states. The potential automatic substitution status of these generic products may adversely affect our ability to generate revenue with PF708 after regulatory approval.

If we do not obtain a therapeutic equivalence designation for PF708 from the FDA, our business may suffer.

We are developing PF708 under the 505(b)(2) regulatory pathway in the United States. Additionally, we have received guidance from the FDA on requirements for a therapeutic equivalence designation, which may allow automatic substitution for the reference listed drug, depending on health care statutes and policies within each of the 50 states. Even with FDA guidance on the requirements, however, demonstrating therapeutic

equivalence may prove difficult, and we may receive regulatory approval without obtaining therapeutic equivalence designation from the FDA, an outcome that could adversely affect our and our collaboration partners' ability to generate revenue from PF708, if approved.

Changes in funding for the FDA and other government agencies could hinder their ability to hire and retain key leadership and other personnel, or otherwise prevent new products and services from being developed or commercialized in a timely manner, which could negatively impact our business.

The ability of the FDA to review and approve new products can be affected by a variety of factors, including government budget and funding levels, ability to hire and retain key personnel and accept the payment of user fees, and statutory, regulatory, and policy changes. Average review times at the agency have fluctuated in recent years as a result. In addition, government funding of other government agencies that fund research and development activities is subject to the political process, which is inherently fluid and unpredictable.

Disruptions at the FDA and other agencies may also slow the time necessary for new drugs to be reviewed and/or approved by necessary government agencies, which would adversely affect our business. For example, over the last several years, including for 35 days beginning on December 22, 2018, the U.S. government has shut down several times and certain regulatory agencies, such as the FDA, have had to furlough critical FDA employees and stop critical activities. If a prolonged government shutdown occurs, it could significantly impact the ability of the FDA to timely review and process our regulatory submissions, which could have a material adverse effect on our business.

If other therapeutic equivalent or generic products to Forteo are approved and successfully commercialized before PF708, our business would suffer.

Other companies may seek approval to manufacture and market therapeutic equivalent or generic product versions of Forteo. If other therapeutic equivalent or generic product versions of Forteo are approved and successfully commercialized before PF708, we and our collaboration partners may never achieve significant market share for PF708, our revenue would be reduced and, as a result, our business, prospects and financial condition could suffer.

Teva Pharmaceuticals USA, Inc. has submitted an ANDA for a generic version of Forteo, and has settled the subsequent patent lawsuit brought by Eli Lilly alleging infringement of the Orange Book-listed patents for Forteo. The terms of the settlement are not public, but Lilly has said it does not anticipate a generic version of Forteo to be marketed before the second half of 2019, at the earliest. Although to date there is no public information indicating that the Teva ANDA has been approved, it is possible that the Teva generic may be approved and marketed before PF708 is approved and marketed, which could adversely affect our and our collaboration partners' ability to generate revenue from PF708, if approved.

Failure to obtain regulatory approval in each regulatory jurisdiction would prevent us and our collaboration partners from marketing our products to a larger patient population and reduce our commercial opportunities.

In order to market our products in the EU, the United States and other jurisdictions, we or our collaboration partners must obtain separate regulatory approvals and comply with numerous and varying regulatory requirements. The EMA is responsible for the assessment of centralized marketing authorization applications for human medicines. This procedure results in a single marketing authorization granted by the European Commission that is valid in all EU Member States, as well as in EEA States Iceland, Liechtenstein and Norway. The time required to obtain approval abroad may differ from that required to obtain FDA approval. When a marketing authorization application is submitted to the EMA, a related scientific evaluation is conducted by the EMA's Committee for Medicinal Products for Human Use (CHMP), and a scientific opinion is prepared concerning the suitability of the product for authorization. This scientific opinion is sent to the European Commission which, before arriving at a final decision on a marketing authorization application, must consult the

Standing Committee on Medicinal Products for Human Use. The Standing Committee is composed of representatives of the EU member states and chaired by a non-voting European Commission representative. The European Parliament also has a related "droit de regard." The European Parliament's role is to ensure that the European Commission has not exceeded its powers in deciding to grant or refuse to grant a marketing authorization. In accordance with the centralized procedure, the maximum timeframe for the evaluation of an MAA is 210 days. This excludes clock stops during which additional information or written or oral explanation is to be provided by the applicant in response to questions of the CHMP.

The foreign regulatory approval process may include all of the risks associated with obtaining FDA approval and we may not obtain foreign regulatory approvals on a timely basis, if at all. Approval by the FDA does not ensure approval by regulatory authorities in other countries, and approval by one foreign regulatory authority does not ensure approval by regulatory authorities in other foreign countries or by the FDA. We may not be able to file for regulatory approvals and may not receive necessary approvals to commercialize our products within the United States or in any market outside the United States. Failure to obtain these approvals would materially and adversely affect our business, financial condition and results of operations.

Even if we and our collaboration partners obtain regulatory approvals for PF708, or any of our other product candidates, we will be subject to ongoing regulatory review.

Even if we and our collaboration partners obtain regulatory approval for PF708, or any of our other product candidates, any products we develop will be subject to ongoing regulatory review with respect to manufacturing, labeling, packaging, storage, advertising, promotion, sampling, record-keeping, conduct of post-marketing studies, and submission of safety, efficacy, and other post-market information, including both federal and state requirements in the United States and requirements of comparable foreign regulatory authorities. Manufacturers and manufacturers' facilities are required to comply with extensive FDA and comparable foreign regulatory authority requirements, including ensuring that quality control and manufacturing procedures conform to cGMP. As such, we and our contract manufacturers will be subject to continual and unannounced review and inspections by the regulatory authorities governing the markets in which we wish to sell our products. Accordingly, we and others with whom we work must continue to expend time, money, and effort in all areas of regulatory compliance, including manufacturing, production, and quality control.

Any regulatory approvals that we and our collaboration partners receive for PF708 or any of our other product candidates may be subject to limitations on the approved indicated uses for which the product may be marketed or on other conditions of approval, or contain requirements for potentially costly post-marketing testing, including Phase 4 trials, and surveillance to monitor the safety and efficacy or the safety, purity, and potency of the product candidate. We and our collaboration partners will be required to promptly report any serious and unexpected adverse events and certain quality or production problems with our products to regulatory authorities, as well as submit other periodic reports. Any new legislation addressing drug or biologic product safety issues could result in delays in product development or commercialization, or increased costs to assure compliance. We and our collaboration partners will have to comply with requirements concerning advertising and promotion for our products. Promotional communications with respect to prescription drug and biologic products are subject to a variety of legal and regulatory restrictions and must be consistent with the information in the product's approved labeling. As such, we will not be allowed to promote our products for indications or uses for which they do not have approval. The holder of an approved NDA, BLA, 351(k) application or marketing authorization application must submit new or supplemental applications and obtain prior approval for certain changes to the approved product, product labeling, or manufacturing process. We or our collaboration partners, could also be asked to conduct post-marketing clinical studies to verify the safety and efficacy of our products in general or in specific patient subsets. An unsuccessful post-marketing study or failure to complete such a study could result in penalties or other adverse consequences, up to and including potential withdrawal of marketing approval.

If a regulatory agency discovers previously unknown problems with a product, such as adverse events of unanticipated severity or frequency, or problems with the facility where the product is manufactured or disagrees

with the promotion, marketing or labeling of a product, or if we or our collaboration partners fail to comply with applicable regulatory requirements, such regulatory agency may impose restrictions on that product or us or our collaboration partners, including requiring withdrawal of the product from the market. If we or our collaboration partners fail to comply with applicable regulatory requirements, a regulatory agency or enforcement authority may subject us to administrative or judicially imposed sanctions or other actions, including, among other things:

- adverse publicity, fines or untitled or warning letters;
- mandated modifications to promotional materials or requirements to provide corrective information to healthcare practitioners;
- a consent decree, which can include imposition of various fines, reimbursements for inspection costs, required due dates for specific actions and penalties for noncompliance;
- civil or criminal penalties;
- injunctions;
- suspending or withdrawing regulatory approval;
- suspending any of our ongoing clinical studies;
- refusing to approve pending applications or supplements to approved applications submitted by us;
- imposing restrictions on our operations, including suspending or closing our contract manufacturers' facilities; or
- seizing or detaining products, or requiring a product recall.

Any government investigation of alleged violations of law could require us or our collaboration partners to expend significant time and resources in response, and could generate negative publicity. Any failure to comply with ongoing regulatory requirements may significantly and adversely affect our or our collaboration partners' ability to commercialize and generate revenue from our products. If regulatory sanctions are applied or if regulatory approval is withdrawn, the value of our company and our operating results will be adversely affected.

We or our collaboration partners will also be subject to various health care fraud and abuse laws, including anti-kickback, false claims and fraud laws, and physician payment transparency laws, and any violations by us of such laws could result in fines or other penalties.

Although we currently do not have any products on the market, if PF708 or any of our other product candidates are approved and we or our collaboration partners begin commercialization, we or our collaboration partners will be subject to healthcare regulation and enforcement by the federal government and the states and EEA Member States and other foreign governments in which we conduct our business.

The shifting commercial compliance environment and the need to build and maintain robust and expandable systems to comply with different compliance and/or reporting requirements in multiple jurisdictions increase the possibility that a healthcare company may violate one or more of the requirements. If our or our collaborators' operations are found to be in violation of any of such laws or any other governmental regulations that apply, we or our collaborators may be subject to penalties, including, without limitation, civil and criminal penalties, damages, fines, the curtailment or restructuring of operations, and exclusion from participation in federal and state healthcare programs, any of which could adversely affect our business and our financial results. Although compliance programs can mitigate the risk of investigation and prosecution for violations of these laws, the risks cannot be entirely eliminated. Any action against us or our collaboration partners for violation of these laws, even if successfully defended against it, could cause us or our collaboration partners to incur significant legal expenses and divert management's attention from the operation of our business. Moreover, achieving and sustaining compliance with applicable federal and state privacy, security and fraud laws may prove costly.

Also, the U.S. Foreign Corrupt Practices Act and similar worldwide anti-bribery laws generally prohibit companies and their intermediaries from making improper payments to non-U.S. officials for the purpose of obtaining or retaining business. We cannot assure investors that our or our collaborators' internal control policies and procedures will prevent violations of these laws, or allegations of such violations, which could result in fines, penalties or prosecution and/or otherwise have a negative impact on our business, results of operations and reputation.

We also may be subject to healthcare privacy and data privacy laws and regulations, and violations of these laws could result in government enforcement actions and create liability for us, private litigation and/or adverse publicity that could negatively affect our business.

We may be subject to laws and regulations covering data privacy and the protection of health-related and other 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 which may affect our business. Numerous federal and state laws and regulations, including state security breach notification laws, state health information privacy laws and federal and state consumer protection laws, govern the collection, use, disclosure, and protection of personal information. Failure to comply with such laws and regulations could result in government enforcement actions and create liability for us (including the imposition of significant penalties), private litigation and/or adverse publicity that could negatively affect our business. In addition, healthcare providers who prescribe our products and research institutions we collaborate with are subject to privacy and security requirements under HIPAA. Although we are not directly subject to HIPAA other than with respect to providing certain employee benefits, we potentially could be subject to criminal penalties if we knowingly obtain or disclose individually identifiable health information maintained by a HIPAA-covered entity in a manner that is not authorized or permitted by HIPAA.

EU member states, Switzerland and other countries have also adopted data protection laws and regulations that impose significant compliance obligations. In the EU, the collection and use of personal health data is governed by the provisions of the General Data Protection Regulation (GDPR). The GDPR entered into application on 25 May 2018, repealing the Data Protection Directive and increasing our responsibility and liability in relation to the processing of personal data of EU subjects. The GDPR, together with the national legislation of the individual EU member states governing the processing of personal data, impose strict obligations and restrictions on the ability to collect, analyze and transfer personal data, including health data from clinical trials and adverse event reporting.

These obligations and restrictions concern, in particular, the consent of the individuals to whom the personal data relates, the information provided to the individuals, the transfer of personal data outside the EU, security breach notifications, security and confidentiality of the personal data, as well as substantial potential fines for breaches of the data protection obligations. Data protection authorities from the different EU member states may interpret the GDPR and national laws differently and impose additional requirements, which add to the complexity of processing personal data of EU subjects.

With respect to the transfer of personal data out of the EU, the GDPR provides that the transfer of personal data to countries that the European Commission does not consider to provide an adequate level of data protection, including the United States, is permitted only on specific legal bases.

Our failure to comply with these laws, or changes in the way in which these laws are implemented, could lead to government enforcement actions and significant penalties against us, and adversely impact our operating results.

Legislative or regulatory healthcare reforms in the United States may make it more difficult and costly for us or our collaboration partners to obtain regulatory approval of PF708, Px563L, RPA563 or any other product candidates and to produce, market, and distribute our products after approval is obtained, if any.

From time to time, legislation is drafted and introduced in Congress that could significantly change the statutory provisions governing the regulatory approval, manufacturing, and marketing of regulated products or the reimbursement thereof. In addition, FDA regulations and guidance may be revised or reinterpreted by the FDA in ways that may significantly affect our business and our products. Any new regulations or guidance, or revisions or reinterpretations of existing regulations or guidance, may impose additional costs or lengthen FDA review times for PF708, Px563L, RPA563 or any other product candidates. We cannot determine how changes in regulations, statutes, policies, or interpretations when and if issued, enacted or adopted, may affect our business in the future. Such changes could require substantial time and impose significant costs, and could materially harm our business and our financial results. In addition, delays in receipt of or failure to receive regulatory clearances or approvals for any other products would harm our business, financial condition, and results of operations.

If efforts by manufacturers of reference products to delay or limit the use of therapeutic equivalent products are successful, sales of therapeutic equivalent products may suffer.

Many manufacturers of reference products have increasingly used legislative, regulatory and other means in attempts to delay regulatory approval of and competition from biosimilars and therapeutic equivalent products. If these or other efforts to delay or block competition are successful, we or our collaboration partners may be unable to sell our therapeutic equivalent product candidates, which could have a material adverse effect on our sales and profitability.

Our and our collaboration partners' future sales will be dependent on the availability and level of coverage and reimbursement from third-party payors who continue to implement cost-cutting measures and more stringent reimbursement standards.

In the United States and internationally, our and our collaboration partners' ability to generate revenue on future sales of our products will be dependent, in significant part, on the availability and level of coverage and reimbursement from third-party payors, such as state and federal governments and private insurance plans. Insurers have implemented cost-cutting measures and other initiatives to enforce more stringent reimbursement standards and likely will continue to do so in the future. These measures include the establishment of more restrictive formularies and increases in the out-of-pocket obligations of patients for such products. In addition, particularly in the U.S. and increasingly in other countries, we will be required to provide discounts and pay rebates to state and federal governments and agencies in connection with purchases of our products that are reimbursed by such entities.

In March 2010, the ACA, was enacted with a goal of reducing the cost of healthcare improving quality and expanding access to care. The ACA has substantially changed the way healthcare is financed by both government and private insurers and has significantly affected the pharmaceutical industry. The ACA, among other things, implemented new price reporting requirements for drugs that are inhaled, infused, instilled, implanted or injected, increased the minimum Medicaid rebates owed by manufacturers under the Medicaid Drug Rebate Program and extended the rebate program to individuals enrolled in Medicaid managed care organizations, added new entity types eligible for participation in the Public Health Service's 340B drug pricing program, established annual fees and taxes on manufacturers of certain prescription drugs, and created a new Medicare Part D coverage gap discount program, in which manufacturers must agree to offer 50% point-of-sale discounts off negotiated prices of applicable reference product drugs to eligible beneficiaries during their coverage gap period as a condition for the manufacturer's outpatient drugs to be covered under Medicare Part D. The Bipartisan Budget Act of 2018 increased such manufacturer point-of-sale discounts in the Medicare Part D coverage gap discount program to 70% effective as of January 1, 2019.

In addition, legislative changes have been proposed and adopted in the U.S. since the ACA was enacted. For example, beginning April 1, 2013, Medicare payments for all items and services, including drugs and biologics, were reduced by 2% per fiscal year under the sequestration required by the Budget Control Act of 2011, as amended by the American Taxpayer Relief Act of 2012. Subsequent legislation extended the 2% reduction to 2027, which went into effect on April 1, 2013 and will stay in effect through 2027 unless additional Congressional action is taken. On January 2, 2013, the American Tax Payer Relief Act of 2012 was signed into law, which, among other things, further reduced Medicare payments to several providers, including hospitals. We expect that additional healthcare reform measures will be adopted in the future, any of which could limit the amounts that federal, state and foreign governments will pay for healthcare products and services, which could result in reduced demand for our products, if approved, or additional pricing pressures. Some of the provisions of the ACA have yet to be fully implemented, and certain provisions have been subject to judicial and Congressional challenges. In addition, there have been efforts by the Trump Administration to repeal or replace certain aspects of the ACA and to alter the implementation of the ACA and related laws. For example, bills affecting the implementation of certain taxes under the ACA have been signed into law. The Tax Cuts and Jobs Act of 2017, or the Tax Act, includes a provision repealing effective January 1, 2019, the tax-based shared responsibility payment imposed by the ACA on certain individuals who fail to maintain qualifying health coverage for all or part of a year commonly referred to as the "individual mandate". On January 22, 2018, President Trump signed a continuing resolution on appropriations for fiscal year 2018 that delayed the implementation of certain ACA-mandated fees, including the so-called "Cadillac" tax on certain high cost employer sponsored insurance plans, the annual fee imposed on certain high cost employer-sponsored insurance plans, the annual fee imposed on certain health insurance providers based on market share and the medical device excise tax on non-exempt medical devices. Additional legislative changes, regulatory changes and judicial challenges related to the ACA remain possible. It is unclear how the ACA and its implementation, as well as efforts to repeal or replace, or invalidate, the ACA, or portions thereof, will affect our business. It is possible such changes or challenges related to the ACA may have an impact on our results of operations and may have a material adverse effect on our results of operations. We cannot predict what other healthcare programs and regulations will ultimately be implemented at the federal or state level or the effect of any future legislation or regulation in the United States may have on our business.

If we successfully commercialize any of our products, we or our collaboration partners may participate in the Medicaid Drug Rebate program. Participation is required for federal funds to be available for our covered outpatient drugs under Medicaid and, if applicable, Medicare Part B. Under the Medicaid Drug Rebate Program, we or our collaboration partners would be required to pay a rebate to each state Medicaid program for our covered outpatient drugs that are dispensed to Medicaid beneficiaries and paid for by a state Medicaid program as a condition of having federal funds being made available to the states for our drugs under Medicaid and, if applicable, Part B of the Medicare program.

Federal law requires that any company that participates in the Medicaid Drug Rebate Program also participate in the Public Health Service's 340B drug pricing program in order for federal funds to be available for the manufacturer's drugs under Medicaid and Medicare Part B. The 340B drug pricing program requires participating manufacturers to agree to charge statutorily-defined covered entities no more than the 340B "ceiling price" for the manufacturer's covered outpatient drugs. These 340B covered entities include a variety of community health clinics and other entities that receive health services grants from the Public Health Service, as well as hospitals that serve a disproportionate share of low-income patients.

In addition, in order to be eligible to have its products paid for with federal funds under the Medicaid and Medicare Part B programs and purchased by certain federal agencies and grantees, a manufacturer also must participate in the U.S. Department of Veterans Affairs, or VA, Federal Supply Schedule, or FSS, pricing program. Under this program, the manufacturer is obligated to make its innovator and single source products available for procurement on an FSS contract and charge a price to four federal agencies, VA, U.S. Department of Defense, or DoD, Public Health Service and U.S. Coast Guard, that is no higher than the statutory Federal Ceiling Price. Moreover, pursuant to regulations issued by the DoD Defense Health Agency to implement

Section 703 of the National Defense Authorization Act for Fiscal Year 2008, manufacturers are required to provide rebates on utilization of their innovator and single source products that are dispensed to TRICARE beneficiaries by TRICARE network retail pharmacies. The requirements under the Medicaid Drug Rebate, 340B, FSS, and TRICARE programs could reduce the revenue we or our collaboration partners may generate from any products that are commercialized in the future and could adversely affect our business and operating results.

If we or our collaboration partners successfully commercialize any of our product candidates and if we or our collaboration partners participate in the Medicaid drug rebate program or other governmental pricing programs, failure to comply with reporting and payment obligations under these programs could result in 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.

The Medicaid Drug Rebate Program and other governmental pricing programs require participating manufacturers to report pricing data to various government agencies. Pricing calculations vary among products and programs and include average manufacturer price and best price for the Medicaid Drug Rebate Program, average sales price for certain categories of drugs that are paid under Part B of the Medicare program, and non-federal average manufacturer price for the VA FSS pricing program. If we or our collaborators successfully commercialize any of our products and participate in such governmental pricing programs, we or our collaboration partners will be liable for errors associated with submission of pricing data. That liability could be significant. For example, knowing submission of false average manufacturer price, average sales price, best price, or non-federal average manufacturer price information to the government, or failure to timely submit such information, could result in liability for significant civil monetary penalties. The foregoing also could be grounds for other sanctions, such as termination from the Medicaid Drug Rebate Program.

Foreign governments tend to impose strict price controls, which may adversely affect our revenue, if any.

In some foreign countries, the pricing of prescription pharmaceuticals is subject to governmental control. In these countries, pricing negotiations with governmental authorities can take considerable time after the receipt of marketing approval for a product. Our existing or future collaboration partners, if any, may elect to reduce the price of our products in order to increase the likelihood of obtaining reimbursement approvals which could adversely affect our revenues and profits. To obtain reimbursement or pricing approval in some countries, we or our collaboration partners may also be required to conduct a clinical trial that compares the cost-effectiveness of our product candidate to other available therapies. If reimbursement of our products is unavailable or limited in scope or amount, or if pricing is set at unsatisfactory levels, our business could be adversely affected.

If in the future we and our collaboration partners are not able to demonstrate biosimilarity of our biosimilar product candidates to the satisfaction of regulatory authorities, those partners will not obtain regulatory approval for commercial sale of our biosimilar product candidates and our future results of operations would be adversely affected.

Our future results of operations depend on our future collaboration partners' ability to obtain regulatory approval for and commercialize our proposed biosimilar products. To obtain regulatory approval for the commercial sale of these product candidates, those partners will be required to demonstrate to the satisfaction of regulatory authorities that, among other things, our proposed biosimilar products are highly similar to biological products already licensed by the FDA pursuant to BLAs, notwithstanding minor differences in clinically inactive components, and that they have no clinically meaningful differences as compared to the marketed biological products in terms of the safety, purity and potency of the products. In the EEA, the similar nature of a biosimilar and a reference product is demonstrated by comprehensive comparability studies covering quality, biological activity, safety and efficacy.

To make a final determination of biosimilarity or interchangeability, regulatory authorities may require additional confirmatory information beyond what our collaboration partners plan to initially submit in

applications for approval, such as more in-depth analytical characterization, animal testing, or further clinical studies. Provision of sufficient information for approval may prove difficult and expensive. We cannot predict whether any of our biosimilar product candidates will meet regulatory authority requirements for approval as a biosimilar or interchangeable product. To date, the FDA has not approved a biosimilar product as being interchangeable to the reference drug.

We and our collaboration partners intend to market our products outside of the United States, and we will be subject to the risks of doing business outside of the United States.

Because we intend to market our product candidates, if approved, outside of the United States, our business is subject to risks associated with doing business outside of the United States. Accordingly, our business and financial results in the future could be adversely affected due to a variety of factors, including:

- efforts to develop an international sales, marketing and distribution organization may increase our expenses, divert our management's attention from the acquisition or development of product candidates or cause us to forgo profitable licensing opportunities in these geographies;
- changes in a specific country's or region's political and cultural climate or economic condition;
- unexpected changes in foreign laws and regulatory requirements;
- difficulty of effective enforcement of contractual provisions in local jurisdictions;
- inadequate intellectual property protection in foreign countries;
- trade-protection measures, import or export licensing requirements such as Export Administration Regulations promulgated by the U.S. Department of Commerce and fines, penalties or suspension or revocation of export privileges;
- the effects of applicable foreign tax structures and potentially adverse tax consequences; and
- significant adverse changes in foreign currency exchange rates.

Moreover, our partners and third-party contractors located outside the U.S. may have inadequate compliance programs or may fail to respect the laws and guidance of the territories in which they operate. 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 also have an adverse effect on our business, financial condition and results of operations.

Risks Relating to Owning Our Common Stock

The market price of our stock may fluctuate significantly, and investors may have difficulty selling their shares.

Our stock is currently traded on NYSE American, but we can provide no assurance that we will be able to maintain an active trading market on NYSE American or any other exchange in the future. The trading volume of our stock tends to be low relative to our total outstanding shares, and we have several stockholders who hold substantial blocks of our stock. As of December 31, 2018, we had 31,467,580 shares of common stock outstanding, and stockholders holding at least 5% of our stock, individually or with affiliated persons or entities, collectively beneficially owned or controlled approximately 43% of such shares. Sales of large numbers of shares by any of our large stockholders could adversely affect our trading price, particularly given our relatively small historic trading volumes. If stockholders holding shares of our common stock sell, indicate an intention to sell, or if it is perceived that they will sell, substantial amounts of their common stock in the public market, the trading price of our common stock could decline.

Since shares of our common stock were sold in our initial public offering in July 2014 at a price of $6.00 per share, our stock price has ranged from $2.07 to $24.41 through December 31, 2018. In addition to the factors

discussed in this "Risk Factors" section and elsewhere in this annual report on Form 10-K, factors that may cause volatility in our share price include:

- actual or anticipated quarterly variation in our results of operations or the results of our competitors;
- announcements by us or our competitors of new commercial products, significant contracts, commercial relationships or capital commitments;
- issuance of new or changed securities analysts' reports or recommendations for our stock;
- developments or disputes concerning our intellectual property or other proprietary rights;
- changes to our organization and management;
- commencement of, or our involvement in, litigation;
- market conditions in the relevant market;
- reimbursement or legislative changes in the relevant market;
- failure to complete significant sales;
- regulatory developments that may impact our product candidates;
- any future sales of our common stock or other securities;
- any major change to the composition of our board of directors or management; and
- general economic conditions and slow or negative growth of our markets.

The stock market in general and market prices for the securities of biopharmaceutical companies like ours in particular, have from time to time experienced volatility that often has been unrelated to the operating performance of the underlying companies. These broad market and industry fluctuations may adversely affect the market price of our common stock, regardless of our operating performance.

We may be subject to securities litigation, which is expensive and could divert management attention.

The market price of our common stock has been and will likely continue to be volatile, and in the past companies that have experienced volatility in the market price of their stock have been subject to securities class action litigation. We may be the target of this type of litigation in the future. Securities litigation against us could result in substantial costs and divert our management's attention from other business concerns, which could seriously harm our business.

If securities or industry analysts publish unfavorable research about our business or cease to cover our business, our stock price and/or trading volume could decline.

The trading market for our common stock may rely, in part, on the research and reports that equity research analysts publish about us and our business. We do not have any control of the analysts or the content and opinions included in their reports. The price of our stock could decline if one or more equity research analysts downgrade our stock or issue other unfavorable commentary or research. If one or more equity research analysts cease coverage of our company or fails to publish reports on us regularly, demand for our stock could decrease, which in turn could cause our stock price or trading volume to decline.

If we sell shares of our common stock in future financings, stockholders may experience immediate dilution and, as a result, the market price of our common stock may decline.

We may from time to time issue additional shares of common stock at a discount from the current trading price of our common stock. As a result, our stockholders would experience immediate dilution upon the purchase

of any shares of our common stock sold at such discount. Any such future issuance, including any issuances pursuant to our "at the market" equity offering program under our sales agreement with William Blair, could result in substantial dilution to our existing stockholders and could cause our stock price to decline. In addition, as opportunities present themselves, we may enter into financing or similar arrangements in the future, including the issuance of debt securities, preferred stock or common stock. If we issue common stock or securities convertible into common stock, our common stockholders would experience additional dilution and, as a result, the market price of our common stock may decline.

Sales of substantial amounts of our common stock in the public markets, or the perception that such sales might occur, could reduce the price that our common stock might otherwise attain and may dilute your voting power and your ownership interest in us.

Sales of a substantial number of shares of our common stock in the public market, or the perception that these sales might occur, could depress the market price of our common stock and could impair our ability to raise capital through the sale of additional equity securities. We are unable to predict the effect that sales may have on the prevailing market price of our common stock. We also register the offer and sale of all shares of common stock that we may issue under our equity compensation plans.

Furthermore, certain of our executive officers have adopted, and other directors and executive officers may in the future adopt, written plans, known as "Rule 10b5-1 Plans," under which they have contracted, or may in the future contract, with a broker to sell shares of our common stock on a periodic basis to diversify their assets and investments. Sales of substantial amounts of our common stock in the public markets, including, but not limited to, sales made by our executive officers and directors pursuant to Rule 10b5-1 Plans, or the perception that these sales could occur, could cause the market price of our common stock to decline.

We are an "emerging growth company" and a "smaller reporting company" and the reduced disclosure requirements applicable to emerging growth companies and smaller reporting companies could make our common stock less attractive to investors.

We are an "emerging growth company," as defined in the Jumpstart Our Business Startups Act (JOBS Act) enacted in April 2012, and may remain an "emerging growth company" for up to five years following the completion of our initial public offering, although, if we have more than $1.07 billion in annual revenue, if the market value of our common stock that is held by non-affiliates exceeds $700 million as of December 31 of any year, or we issue more than $1.0 billion of non-convertible debt over a three-year period before the end of that five-year period, we would cease to be an "emerging growth company" as of the following December 31. For as long as we remain an "emerging growth company," we are permitted and intend to rely on exemptions from certain disclosure requirements that are applicable to other public companies that are not "emerging growth companies." These exemptions include:

- not being required to comply with the auditor attestation requirements in the assessment of our internal control over financial reporting;
- not being required to comply with any requirement that may be adopted by the Public Company Accounting Oversight Board regarding mandatory audit firm rotation or a supplement to the auditor's report providing additional information about the audit and the financial statements;
- reduced disclosure obligations regarding executive compensation; and
- exemptions from the requirements of holding a nonbinding advisory vote on executive compensation and shareholder approval of any golden parachute payments not previously approved.

We have taken advantage of reduced reporting burdens in our reports filed with the Securities and Exchange Commission (SEC). In addition, the JOBS Act provides that an emerging growth company can take advantage of an extended transition period for complying with new or revised accounting standards, delaying the adoption of

these accounting standards until they would apply to private companies. We have elected to avail ourselves of this exemption and, as a result, our financial statements may not be comparable to the financial statements of reporting companies who are required to comply with the effective dates for new or revised accounting standards that are applicable to public companies. Notwithstanding the above, we are also currently a "smaller reporting company." Specifically, similar to "emerging growth companies," "smaller reporting companies" are able to provide simplified executive compensation disclosures in their filings and have certain other decreased disclosure obligations in their SEC filings. We cannot predict whether investors will find our common stock less attractive as a result of our reliance on these exemptions. If some investors find our common stock less attractive as a result, there may be a less active trading market for our common stock and the market price of our common stock may be reduced or more volatile.

If we fail to maintain effective internal control over financial reporting in the future, the accuracy and timing of our financial reporting may be adversely affected.

As a public company, we are subject to reporting and other obligations under the Securities Exchange Act of 1934, as amended, or the Exchange Act, including the requirements of SOX Section 404, which require annual management assessments of the effectiveness of our internal control over financial reporting. However, our auditors will not be required to formally attest to the effectiveness of our internal control over financial reporting pursuant to SOX Section 404 until we are no longer an emerging growth company if we continue to take advantage of the exemptions available to us through the JOBS Act.

If we identify new material weaknesses in our internal control over financial reporting or we are unable to successfully remediate any future material weaknesses in our internal control over financial reporting, the accuracy and timing of our financial reporting may be adversely affected, we may be unable to maintain compliance with securities laws and NYSE American listing requirements regarding the timely filing of periodic reports, investors may lose confidence in our financial reporting, and our stock price may decline.

Additionally, our independent registered public accounting firm is not required to and did not perform an evaluation of our internal control over financial reporting during any period in accordance with the provisions of the Sarbanes-Oxley Act due to a transition period established by the rules of the Securities and Exchange Commission (SEC) for newly public companies that have not lost their "emerging growth company" status as defined in the JOBS Act. Had our independent registered public accounting firm performed an evaluation of our internal control over financial reporting in accordance with the provisions of the Sarbanes-Oxley Act, additional control deficiencies amounting to significant deficiencies or material weaknesses may have been identified. We cannot be certain as to when we will be able to implement the requirements of Section 404 of the Sarbanes-Oxley Act. If we fail to implement the requirements of Section 404 in a timely manner, we might be subject to sanctions or investigation by regulatory agencies such as the SEC. In addition, failure to comply with Section 404 or the report by us of a significant deficiency or material weakness may cause investors to lose confidence in our financial statements, and the trading price of our common stock may decline. If we fail to remedy any significant deficiency or material weakness, our financial statements may be inaccurate, our access to the capital markets may be restricted and the trading price of our common stock may decline.

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

We expect to generate a tax net operating loss for 2019. The 2018 net operating loss carryforwards are available to offset future taxable income, if any, until such unused losses expire. Under Sections 382 and 383 of the Internal Revenue Code of 1986, as amended, if a corporation undergoes an "ownership change," generally defined as a greater than 50 percentage point change (by value) in its equity ownership by certain stockholders over a three-year period, the corporation's ability to use its pre-change net operating loss carryforwards, or NOLs, and other pre-change tax attributes (such as research tax credits) to offset its post-change income or taxes may be limited. We have not analyzed whether we have experienced an ownership change for purposes of Sections 382 and 383 of the Code since 2014. We may have experienced an ownership change in connection with

the sale of securities pursuant to a predecessor registration statement or otherwise and we may experience ownership changes in the future as a result of shifts in our stock ownership. We plan to complete a Section 382/383 analysis as of December 31, 2018 to determine if we have had an ownership change. As a result, if or when we earn net taxable income, our ability to use our pre-change NOLs to offset such taxable income may be subject to limitations. Similar provisions of state tax law may also apply to limit our use of accumulated state tax attributes. As a result, even if we attain profitability, we may be unable to use a material portion of our NOLs and other tax attributes, which could adversely affect our future cash flows.

We are incurring increased costs as a result of operating as a public company and our management is required to devote substantial time to new compliance initiatives and corporate governance practices including maintaining an effective system of internal control over financial reporting.

As a public company, and increasingly after we are no longer an "emerging growth company" and/or "smaller reporting company," we are incurring significant legal, accounting and other expenses that we did not incur as a private company. In addition, the Sarbanes-Oxley Act and rules subsequently implemented by the SEC, and the NYSE American impose numerous requirements on public companies, including establishment and maintenance of effective disclosure and financial controls and corporate governance practices. Also, the Securities Exchange Act of 1934 (Exchange Act), as amended, requires, among other things, that we file annual, quarterly and current reports with respect to our business and operating results. Our management and other personnel devote a substantial amount of time to comply with these laws and regulations. These requirements have increased and will continue to increase our legal, accounting, and financial compliance costs and have made and will continue to make some activities more time consuming and costly. For example, we expect these rules and regulations to make it more difficult and more expensive for us to obtain director and officer liability insurance, and we may be required to incur substantial costs to maintain the same or similar coverage. These rules and regulations could also make it more difficult for us to attract and retain qualified persons to serve on our board of directors or our board committees or as executive officers. These rules and regulations are often subject to varying interpretations, in many cases due to their lack of specificity, and, as a result, their application in practice may evolve over time as new guidance is provided by regulatory and governing bodies. This could result in continuing uncertainty regarding compliance matters and higher costs necessitated by ongoing revisions to disclosure and changing governance practices.

The Sarbanes-Oxley Act requires, among other things, that we assess the effectiveness of our internal control over financial reporting annually and the effectiveness of our disclosure controls and procedures quarterly. In particular, Section 404(a) of the Sarbanes-Oxley Act requires us to perform system and process evaluation and testing of our internal control over financial reporting to allow management to report on the effectiveness of our internal control over financial reporting. Section 404(b) of Sarbanes-Oxley Act (Section 404(b)) also requires our independent registered public accounting firm to attest to the effectiveness of our internal control over financial reporting. As an "emerging growth company," we are availing ourselves of the exemption from the requirement that our independent registered public accounting firm attest to the effectiveness of our internal control over financial reporting under Section 404(b). However, we may no longer avail ourselves of this exemption when we are no longer an "emerging growth company." When our independent registered public accounting firm is required to undertake an assessment of our internal control over financial reporting, the cost of our compliance with Section 404(b) will correspondingly increase. Our compliance with applicable provisions of Section 404 requires us and will continue to require us to incur substantial accounting expense and expend significant management time on compliance-related issues as we implement additional corporate governance practices and comply with reporting requirements.

Furthermore, investor perceptions of our company may suffer if deficiencies are found, and this could cause a decline in the market price of our stock. Irrespective of any required compliance with Section 404, any failure of our internal control over financial reporting could have a material adverse effect on our stated operating results and harm our reputation. If we are unable to implement these requirements effectively or efficiently, it could harm our operations, financial reporting, or financial results and could result in an adverse opinion on our internal controls from our independent registered public accounting firm.

Our directors, executive officers and principal stockholders will continue to have substantial control over us and could limit investors' ability to influence the outcome of key transactions, including transactions that would cause a change of control.

As of December 31, 2018, our executive officers, directors and stockholders who owned more than 5% of our outstanding common stock and their respective affiliates beneficially owned or controlled approximately 45% of the outstanding shares of our common stock. Accordingly, these executive officers, directors and stockholders and their respective affiliates, acting as a group, have substantial influence over the outcome of corporate actions requiring stockholder approval, including the election of directors, any merger, consolidation or sale of all or substantially all of our assets or any other significant corporate transactions. These stockholders may therefore delay or prevent a change of control of us, even if such a change of control would benefit our other stockholders. The significant concentration of stock ownership may adversely affect the trading price of our common stock due to investors' perception that conflicts of interest may exist or arise.

Claims for indemnification by our directors and officers may reduce our available funds to satisfy successful third-party claims against us and may reduce the amount of money available to us.

Our amended and restated certificate of incorporation and amended and restated bylaws provide that we will indemnify our directors and officers, in each case to the fullest extent permitted by Delaware law. In addition, as permitted by Section 145 of the Delaware General Corporation Law, our amended and restated bylaws and our indemnification agreements that we have entered into with our directors and officers provide that:

- We will indemnify our directors and officers for serving us in those capacities, or for serving other business enterprises at our request, to the fullest extent permitted by Delaware law. Delaware law provides that a corporation may indemnify such person if such person acted in good faith and in a manner such person reasonably believed to be in or not opposed to the best interests of the registrant and, with respect to any criminal proceeding, had no reasonable cause to believe such person's conduct was unlawful.
- We may, in our discretion, indemnify employees and agents in those circumstances where indemnification is permitted by applicable law.
- We are required to advance expenses, as incurred, to our directors and officers in connection with defending a proceeding, except that such directors or officers shall undertake to repay such advances if it is ultimately determined that such person is not entitled to indemnification.
- We will not be obligated pursuant to our amended and restated bylaws to indemnify a person with respect to proceedings initiated by that person against us or our other indemnitees, except with respect to proceedings authorized by our board of directors or brought to enforce a right to indemnification.
- The rights conferred in our amended and restated bylaws are not exclusive, and we are authorized to enter into indemnification agreements with our directors, officers, employees and agents and to obtain insurance to indemnify such persons.
- We may not retroactively amend our amended and restated bylaw provisions to reduce our indemnification obligations to directors, officers, employees and agents.

To the extent that a claim for indemnification is brought by any of our directors or officers, it would reduce the amount of funds available for use in our business.

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

Provisions in our certificate of incorporation and bylaws may have the effect of delaying or preventing a change of control or changes in our management. Our amended and restated certificate of incorporation and amended and restated bylaws include provisions that:

- authorize our board of directors to issue, without further action by the stockholders, up to 10,000,000 shares of undesignated preferred stock;
- require that any action to be taken by our stockholders be effected at a duly called annual or special meeting and not by written consent;
- specify that special meetings of our stockholders can be called only by our board of directors, the chairman of the board of directors, or the chief executive officer;
- establish an advance notice procedure for stockholder approvals to be brought before an annual meeting of our stockholders, including proposed nominations of persons for election to our board of directors;
- establish that our board of directors is divided into three classes, Class I, Class II and Class III, with each class serving staggered three-year terms;
- provide that our directors may be removed only for cause;
- provide that vacancies on our board of directors may be filled only by a majority of directors then in office, even though less than a quorum;
- specify that no stockholder is permitted to cumulate votes at any election of directors; and
- require a super-majority of votes to amend certain of the above-mentioned provisions.

These provisions may frustrate or prevent any attempts by our stockholders to replace or remove our current management by making it more difficult for stockholders to replace members of our board of directors, which is responsible for appointing the members of our management. In addition, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporation Law, which limits the ability of stockholders owning in excess of 15% of our outstanding voting stock to merge or combine with us.

We have broad discretion in the use of the net proceeds from our public offerings, including our "at the market" offering, and may not use them effectively.

We have broad discretion as to how to spend and invest the proceeds from our public offerings, including our "at-the-market" offering with William Blair, and we may spend or invest these proceeds in a way with which our stockholders disagree. Accordingly, investors will need to rely on our judgment with respect to the use of these proceeds and these uses may not yield a favorable return to our stockholders. In addition, until the net proceeds are used, they may be placed in investments that do not produce significant income or that may lose value.

With the exception of the issuance of shares of common stock to our preferred stockholders in connection with the payment of all accrued and unpaid dividends in connection with our initial public offering, we do not anticipate paying any cash dividends in the foreseeable future.

At the closing of our initial public offering, our board of directors issued shares of common stock to pay all accrued but unpaid dividends on our convertible preferred stock. With the exception of this dividend, we do not anticipate paying cash dividends on any classes of our capital stock in the foreseeable future. We currently intend

to retain our future earnings for the foreseeable future to fund the development and growth of our business. As a result, capital appreciation, if any, of our common stock will be the sole source of gain on an investment in our common stock for the foreseeable future.

Item 1B. ***Unresolved Staff Comments***

None.

Item 2. ***Properties***

As of December 31, 2018, we leased a total of approximately 46,959 square feet of office and laboratory space located at 10790 and 10788 Roselle Street, San Diego, CA 92121. The lease expires on March 31, 2024. We believe that our existing facilities are adequate to meet our business requirements for the foreseeable future and that additional space will be available on commercially reasonable terms, if required.

Item 3. ***Legal Proceedings***

In the normal course of business, we are from time to time involved in legal proceedings or potential legal proceedings, including matters involving employment, intellectual property, or others. Although the results of litigation and claims cannot be predicted with certainty, we currently believe that the final outcome of any currently pending matters would not have a material adverse effect on our business, operating results, financial condition, or cash flows. Regardless of the outcome, litigation can have an adverse impact on us because of defense and settlement costs, diversion of management resources, and other factors.

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 and Holders of Record

Our common stock has been listed on the NYSE American under the symbol "PFNX" since July 24, 2014. Prior to that date, there was no public trading market for our common stock. As of March 1, 2019, we had 21 holders of record of our common stock. The actual number of stockholders is greater than this number of record holders and includes stockholders who are beneficial owners but whose shares are held in street name by brokers and other nominees. This number of holders of record also does not include stockholders whose shares may be held in trust by other entities.

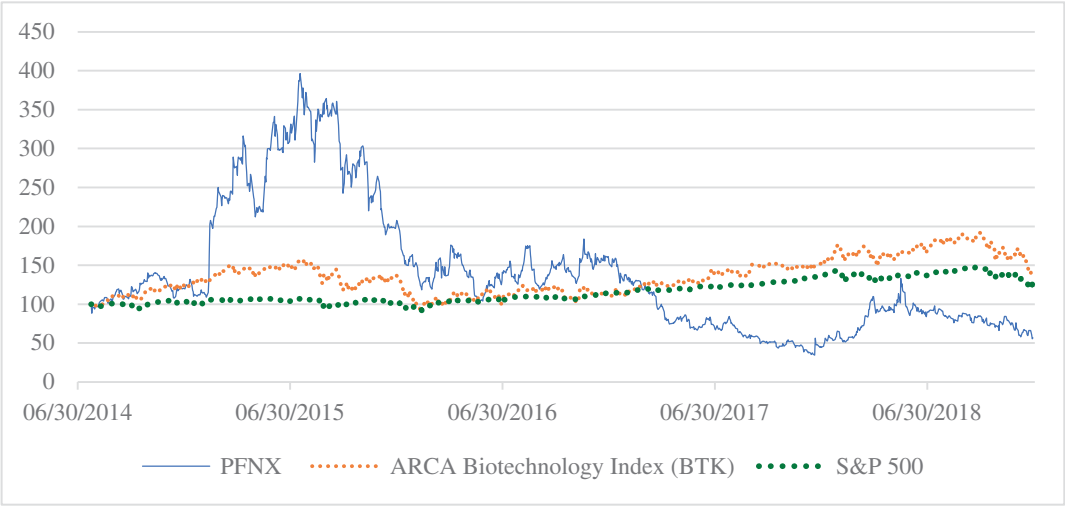
Dividends

With the exception of common stock issued in connection with the payment of all accrued but unpaid dividends upon the conversion of all preferred stock upon the completion of our initial public offering, we have not made any distributions on our common stock and do not intend to make any distributions on our common stock for the foreseeable future. Instead, we anticipate that all of our earnings in the foreseeable future will be used for the operation and growth of our business.

Stock Performance Graph

This performance graph shall not be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, or the Exchange Act, or incorporated by reference into any filing of Pfenex Inc. under the Securities Act of 1933, as amended, or the Exchange Act.

The graph below shows the cumulative total stockholder return assuming the investment of $100 as of the close on July 24, 2014, the first day of trading for Pfenex Inc.'s common stock, (and the reinvestment of dividends thereafter) in each of (i) Pfenex Inc.'s common stock, (ii) the ARCA Biotechnology Index and, (iii) the S&P 500 Index. The comparisons in the graph below are based upon historical data and are not indicative of, or intended to forecast, future performance of our common stock or the index. The prices are as of the close of PFNX's first trading day to the close at December 31, 2018.



Securities Authorized for Issuance Under Equity Compensation Plans

The information required by this Item regarding equity compensation plans is incorporated by reference to the information set forth in PART III Item 12 of this Annual Report on Form 10-K.

Recent Sales of Unregistered Securities and Issuer Purchases of Equity Securities

(a) Sales of Unregistered Securities

None.

(b) Issuer Purchases of Equity Securities

None.

Item 6. ***Selected Financial Data***

The following selected historical financial data below should be read in conjunction with Item 7, "*Management's Discussion and Analysis of Financial Condition and Results of Operations,*" our financial statements, and the related notes appearing in Item 8, "*Financial Statements and Supplementary Data*", of this Annual Report on Form 10-K to fully understand factors that may affect the comparability of the information presented below.

The consolidated statements of operations data for the years ended December 31, 2018, 2017, and 2016 and the consolidated balance sheet data as of December 31, 2018 and 2017 are derived from our audited financial statements appearing in Item 8, "*Financial Statements and Supplementary Data*," of this Annual Report on Form 10-K. The consolidated statements of operations data for the year ended December 31, 2015 and 2014 and the consolidated balance sheet data as of December 31, 2016, 2015, and 2014 are derived from audited financial statements not included in this Annual Report on Form 10-K. Our historical results are not necessarily indicative of the results to be expected in the future.

	Years Ended December 31,				
	2018	2017	2016	2015	2014
	(in thousands, except for per share data)				
Revenues	$ 14,857	$ 28,780	$60,194	$ 9,583	$10,644
Expense:					
Cost of revenues[1]	5,022	5,156	5,313	4,640	7,233
Research and development[1]	33,854	31,925	32,418	18,183	4,125
Selling, general and administrative	15,832	17,674	17,340	14,598	9,003
Total expense	54,708	54,755	55,071	37,421	20,361
(Loss) income from operations	(39,851)	(25,975)	5,123	(27,838)	(9,717)
Other income (expense), net	258	119	149	74	(77)
(Loss) income before income taxes	(39,593)	(25,856)	5,272	(27,764)	(9,794)
Income tax benefit (expense)	—	172	209	(452)	—
Net (loss) income	$(39,593)	$(25,684)	$ 5,481	$(28,216)	$ (9,794)
Net (loss) income attributable to common stockholders	$(39,593)	$(25,684)	$ 5,481	$(28,216)	$ (9,794)
Basic and diluted net (loss) income per share attributable to common stockholders[2]	$ (1.40)	$ (1.09)	$ 0.23	$ (1.26)	$ (1.04)
Basic weighted-average shares used to compute net (loss) income per share attributable to common stockholders	28,340	23,503	23,389	22,376	9,441
Diluted weighted-average shares used to compute net (loss) income per share attributable to common stockholders	28,340	23,503	23,688	22,376	9,441

(1) Please refer to Note 1 of our consolidated financial statements for an explanation of the method used to recognize cost of revenues and research and development expense.

(2) All share, per-share and related information have been retroactively adjusted, where applicable, to reflect the impact of a 2.812-for-1 reverse stock split, which was effected on June 27, 2014.

Other Financial Data

	As of December 31,				
	2018	2017	2016	2015	2014
	(in thousands)				
Balance Sheet Data:					
Cash and cash equivalents and short-term investments	$56,220	$57,664	$81,501	$106,162	$45,722
Restricted cash	200	200	—	3,959	3,955
Accounts and unbilled receivables, net	5,171	1,306	2,822	2,683	1,584
Inventory	—	—	—	24	23
Property and equipment, net	7,671	7,397	5,246	3,179	2,310
Goodwill and intangibles	9,825	10,348	10,878	11,409	11,940
Other	2,191	2,476	2,675	4,278	5,489
Total assets	81,278	79,391	103,122	131,694	71,023
Current liabilities, excluding debt	12,133	11,046	10,696	6,883	3,762
Deferred revenue	7,817	10,163	12,255	48,095	201
Debt	—	—	—	3,813	3,813
Other	191	419	26	1,722	3,373
Total liabilities	20,141	21,628	22,977	60,513	11,149
Stockholders' equity (deficit)	61,137	57,763	80,145	71,181	59,874
Total liabilities and stockholders' equity	81,278	79,391	103,122	131,694	71,023

Item 7. *Management's Discussion and Analysis of Financial Condition and Results of Operations*

The following discussion and analysis of our financial condition and results of operations should be read in conjunction with our financial statements and related notes appearing elsewhere in this Annual Report on Form 10-K. In addition to historical financial information, the following discussion contains forward-looking statements that reflect our plans, estimates and beliefs. Statements containing words such as "may," "believe," "anticipate," "expect," "intend," "plan," "project," "projections," "business outlook," "estimate," or similar expressions constitute forward-looking statements. Our actual results could differ materially from those contained in or implied by any forward-looking statements. Factors that could cause or contribute to these differences include those discussed below, in the section captioned "Risk Factors," and elsewhere in this Annual Report on Form 10-K.

Overview

We are a clinical-stage development and licensing biotechnology company focused on leveraging our *Pf*ēnex Expression Technology to develop and improve protein therapies for unmet patient needs. Using the patented *Pf*ēnex Expression Technology platform, we have created an advanced pipeline of potential therapeutic equivalents, vaccines, biologics and biosimilars. We also use our *Pf*ēnex Expression Technology platform to produce CRM197, a diphtheria toxoid carrier protein used in prophylactic and therapeutic vaccine candidates under development by third parties. Our lead product candidates are PF708, under development as a therapeutic equivalent drug candidate to Forteo® (teriparatide) for the treatment of osteoporosis, and our novel anthrax vaccine candidates, Px563L and RPA563, funded through an advanced development contract with the U.S. government. In December 2018, we submitted our new drug application (NDA) for PF708 to the FDA and the FDA accepted the submission for substantive review in February 2019. In addition, we are developing hematology/oncology products in collaboration with Jazz Pharmaceuticals Ireland Limited (Jazz).

Product Candidates and Collaborations

The following table summarizes certain information about our lead product candidates and collaborations:

Product Candidate	Branded Reference Drug	Program	Proposed Indication
Proposed Therapeutic Equivalent			
PF708—Teriparatide	Forteo	• Licensed in the United States, EU, MENA, and Rest of World to Alvogen • Licensed in Mainland China, Hong Kong, Singapore, Malaysia, Thailand to NT Pharma	Osteoporosis
Multiple Hematology/Oncology Product Candidates	Various	• Jazz Pharmaceuticals Ireland Limited	Various
Novel Vaccines			
Px563L and RPA563—rPA based anthrax vaccines	N/A	• U.S. Government Funded	Anthrax post-exposure prophylaxis

Our lead product candidates and collaborations include the following:

- **PF708—our teriparatide drug candidate.** PF708 is being developed as a therapeutic equivalent candidate to Forteo, which is approved and marketed by Eli Lilly and Company for the treatment of osteoporosis in certain patients with a high risk of fracture. Forteo achieved $1.6 billion in global product sales in 2018. PF708 is being developed pursuant to the 505(b)(2) regulatory pathway in the U.S. and references Forteo as the Reference Listed Drug. In November 2017, we announced the interim pharmacokinetic (PK) results from Study PF708-301, which also compared the effect of PF708 and Forteo in osteoporosis patients. In May 2018, we announced positive top-line results from our PF708-301 study, which showed comparable overall profiles between PF708 and Forteo after 24 weeks of daily injection in osteoporosis patients.

The PF708-301 study enrolled a total of 181 patients, with 90 patients receiving PF708 and 91 receiving Forteo. There were 82 patients who completed the study in the PF708 treatment group, compared with 81 patients in the Forteo treatment group. The primary study endpoint was anti-drug antibody (ADA) incidence after 24 weeks of drug treatment. The secondary study endpoints included mean percentage changes in lumbar-spine bone mineral density (BMD) and median percentage changes in bone turnover markers (BTM) after 24 weeks of drug treatment, as well as pharmacokinetic (PK) parameters for up to four hours after the first dose. Safety study endpoints were incidences of adverse events (AE) and serious adverse events (SAE).

There were two PF708-treated patients and two Forteo-treated patients that developed ADA during the study. These low rates of immunogenicity are consistent with historical Forteo results (~3%) in postmenopausal osteoporosis patients. At Week 24, there were two ADA-positive findings for PF708 compared with none for Forteo, but the difference was not statistically significant. The ADA findings in the two PF708 patients were low in titer and resolved during follow-up. One of the two patients had *in vitro* neutralizing activity transiently detected at Week 4. However, pharmacological activity, as assessed by increases in BMD and BTM, was observed during the study for this patient. There were no apparent safety issues or abnormal serum calcium levels related to ADA or neutralizing antibody findings. These findings are consistent with observations in follow-on biologics and biosimilars approved in the United States, with almost all of the products demonstrating an ADA treatment difference of less than 5% in comparative patient studies. The overall ADA results are shown in Table 1, and individual titer results for all ADA-positive patients are shown in Table 2 (below).

PF708 and Forteo demonstrated comparable effects on lumbar-spine BMD, P1NP (N-terminal propeptide of type 1 procollagen), which is a marker of bone formation and CTX (cross-linked C-terminal telopeptide of type 1 collagen), which is a marker of bone resorption. There were no statistically significant differences in any of these parameters between PF708 and Forteo. The lumbar-spine BMD results are shown in Figure 1 (below), and BTM results are shown in Figure 2 (below).

There were no significant imbalances in AE incidences or severity profiles between PF708 and Forteo. Treatment-emergent AE and SAE profiles are shown in Table 3 (below), and the severity of treatment-emergent AEs is shown in Table 4 (below).

The PF708-301 study assessed PF708 and Forteo across multiple endpoints in both female and male osteoporosis patients and showed comparable overall profiles. We believe the PF708-301 and PF708-101 study results meet the requirements for demonstrating clinical safety, effectiveness and bioequivalence. These results from the PF708-301 study, along with the previously announced bioequivalence findings from the PF708-101 study in healthy subjects, supported our PF708 NDA application submitted in December 2018. In July 2018 we had a constructive Pre-NDA meeting with the FDA which confirmed there were no additional clinical, nonclinical or analytical comparability studies requested by the FDA. We filed our NDA in December 2018 and the FDA accepted our submission for substantive review in February 2019, which we believe puts us on-track for a potential commercial launch in the United States as early as the fourth quarter of 2019, subject to FDA approval of the application and other factors.

PF708 is being developed pursuant to the 505(b)(2) regulatory pathway in the U.S. and references Forteo as the Reference Listed Drug. While we believe our application strategy could lead to launch in the U.S. as early as the fourth quarter of 2019, subject to FDA approval of the application and other factors, it is possible that various factors, including patent litigation by Eli Lilly and Company, may delay approval and launch. We believe that our existing cash and cash equivalents and our cash inflow from operations will be sufficient to meet our anticipated cash needs for at least the next 12 months, including funding all necessary activities leading up to and including meeting our obligations to contractually support our partner on the potential commercial launch in the United States as early as the fourth quarter of 2019, subject to FDA approval of the NDA and other factors. We believe the clinical program in the U.S. may be leveraged for regulatory filings in other geographies, such as the European Union (EU).

Table 1. Study PF708-301 Overall Anti-Drug Antibody Results

Time (wk)	PF708		Forteo		P value
0	0/90	0%	0/91	0%	1.00
1	1/87	1.2%	0/90	0%	0.49
4	1/86	1.2%	0/89	0%	0.49
12	2/82	2.4%	2/86	2.3%	1.00
24	2/81	2.5%	0/81	0%	0.50
24 week overall	2/87	2.3%	2/90	2.2%	1.00

Table 2. Study PF708-301 Anti-Drug Antibody Titer Results for Individual Patients

Time (wk)	PF708 Patient 1	PF708 Patient 2	Forteo Patient 1	Forteo Patient 2
0	Neg	Neg	Neg	Neg
1	1:1	Neg	Neg	Neg
4	1:1*	Neg	Neg	Neg
12	1:1	1:1	1:8	1:2
24	1:1	1:1	Neg	Neg
Follow-up	Neg	Neg	N/A	N/A

* In vitro neutralizing activity detected; pharmacological activity, as assessed by changes in BMD and BTM, was observed during the study for this patient.

Antibody titer measures how much ADA is present in a positive sample. A value of 1:1 is the lowest possible finding, whereas a value of 1:8 represents an 8-fold increase.

Neg: negative; N/A: not applicable

Table 3. Study PF708-301 Treatment-Emergent Adverse Event Profiles

Number and Percent of Patients with:	PF708		Forteo	
Any AE	75	83.3%	73	80.2%
Any SAE	6	6.7%	8	8.8%
Any treatment-related AE	48	53.3%	45	49.5%
Any AE leading to early withdrawal	3	3.3%	5	5.5%
Any AE leading to death	0	0%	0	0%

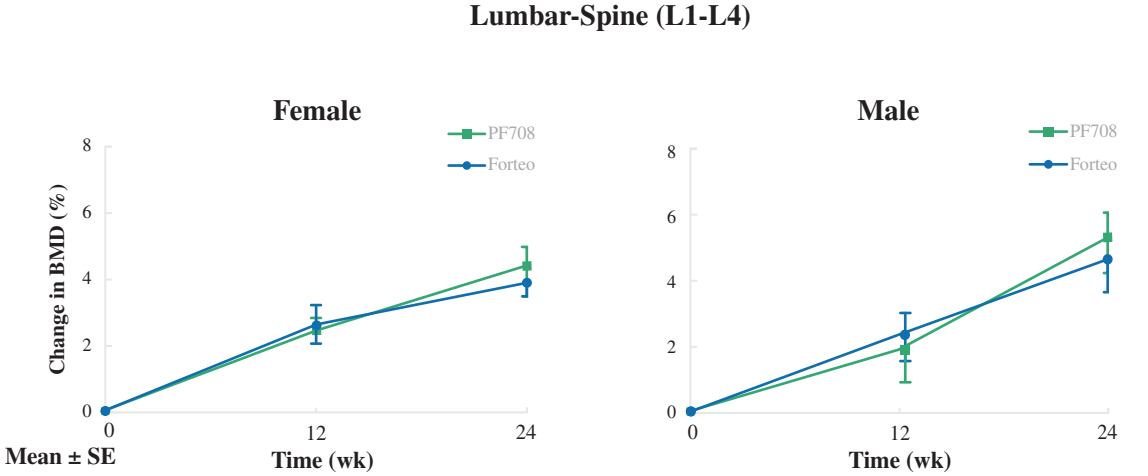
AE: adverse event; SAE: serious adverse event

Table 4. Study PF708-301 Severity of Treatment-Emergent Adverse Events

		Grade 1	Grade 2	Grade 3	Grade 4	Total
All Findings	PF708	169	84	6	2	261
	Forteo	203	61	9	3	276
		Grade 1	**Grade 2**	**Grade 3**	**Grade 4**	**Total**
Injection Site Findings	PF708	36	1	0	0	37
	Forteo	33	1	0	0	34

Severity of AEs was assessed according to the Common Terminology Criteria for Adverse Events. Version 4.03

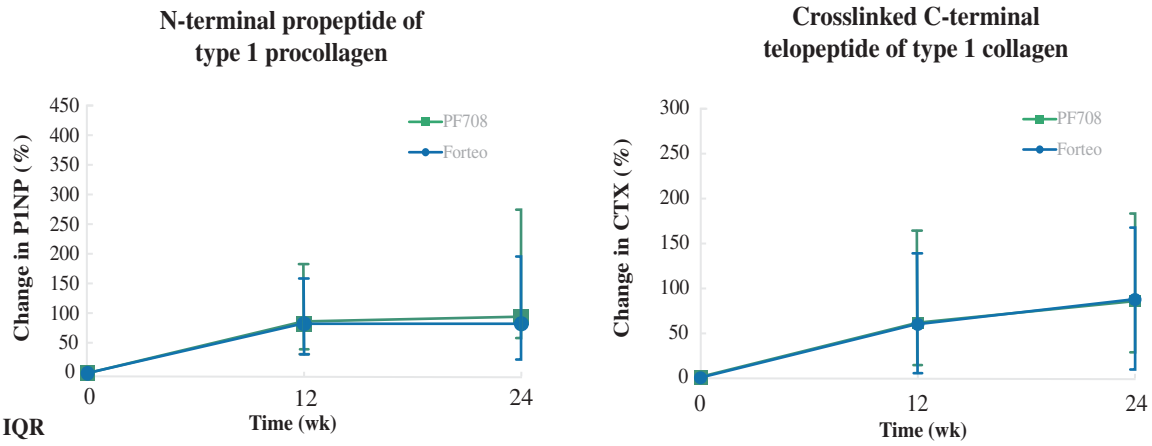
Figure 1. Study PF708-301 Lumbar-Spine Bone Mineral Density Results in Female and Male Patients



No. of subjects

PF708	**60**	**60**	**58**	**23**	**23**	**23**
Forteo	**62**	**61**	**59**	**22**	**22**	**20**

Figure 2. Study PF708-301 Bone Turnover Markers Results in All Patients



Median ± IQR						
No. of patients						
PF708	**85**	**79**	**78**	**80**	**79**	**76**
Forteo	**85**	**84**	**80**	**86**	**85**	**79**

IQR: interquartile range

In June 2018, we and Alvogen entered into a Development and License Agreement pursuant to which Alvogen received the exclusive right to commercialize and manufacture PF708 in the United States. In February 2019, we expanded our collaboration, granting Alvogen exclusive rights to commercialize and manufacture PF708 in the EU, certain countries in the Middle East and North Africa (MENA), and the ROW territories (the latter defined as all countries outside of the EU, US and MENA, excluding Mainland China, Hong Kong, Singapore, Malaysia and Thailand). We believe this collaboration leverages Alvogen's established international experience and expertise in regulatory, IP and supply chain activities, as well as its established network of specialty marketing and sales pharmaceutical companies in these regions. Subject to applicable regulatory approvals, PF708 will be commercialized in Europe and Switzerland by Theramex, a leading global specialty pharmaceutical company dedicated to Women's Health, in MENA by SAJA, a Tamer Group company, and in ROW by Alvogen's current and/or future commercialization partners. Under the terms of the agreements, Alvogen will be responsible for the local activities through Theramex, SAJA and its other commercialization partners and for overseeing any clinical development, regulatory, litigation, commercial manufacturing and commercialization. We are eligible to receive additional upfront and milestone payments of $2.5 million for the EU and MENA and additional potential milestone payments for ROW. For EU, MENA, and ROW, we may also be eligible to receive a gross profit split of up to 60% on product sales, if approved, depending on geography and cost of goods sold.

In April 2018, we and NT Pharma entered into a Development and License Agreement (NT Pharma Agreement), pursuant to which we granted an exclusive license to NT Pharma to commercialize PF708 in Mainland China, Hong Kong, Singapore, Malaysia and Thailand and a non-exclusive license to conduct development activities in such territories with respect to PF708. In accordance with the agreement, we received a payment of $2.5 million upon signing the NT Pharma Agreement and may be eligible to receive additional payments of up to $22.5 million based on the achievement of certain development, regulatory, and sales-related milestones. We may also be eligible to receive double-digit royalties on net sales of PF708. NT Pharma is responsible for any further development required to achieve regulatory approval as well as commercialization activities in the applicable territories.

- **Jazz Collaboration—multiple early stage hematology/oncology product candidates with Jazz.** In July 2016, we entered into a license and option agreement with Jazz, pursuant to which we and Jazz are collaboratively developing hematology/oncology products, including PF743, a recombinant

crisantaspase, and PF745, a recombinant crisantaspase with half-life extension technology, and Jazz will have the exclusive right to manufacture and commercialize such products throughout the world. In addition, pursuant to the agreement, we have granted Jazz certain other rights to negotiate the exclusive right to develop, manufacture and commercialize throughout the world other hematology/oncology products that are currently or in the future may be developed by us. In the third quarter of 2017, we achieved a process development milestone associated with this collaboration. In December 2017, we and Jazz signed an amended and restated agreement under which we will be eligible to receive an additional $43.5 million in amendment fee and development milestone payments as compared to the 2016 agreement, increasing the total value of upfront, option and amendment fee payments and potential payments for the achievement of development, regulatory and sales-related milestones associated with the collaboration to an aggregate of $224.5 million. We will also continue to be eligible to receive tiered royalties on worldwide sales of any products resulting from the collaboration at rates reduced from those under the 2016 agreement. In December 2017, as part of the amended and restated agreement, we received a total payment of $18.5 million, consisting of an upfront payment of $5.0 million and a payment of $13.5 million for development achievement. In the second quarter of 2018, we achieved two development milestones and received $0.8 million for successful achievement of process development milestones for PF745.

- **Px563L and RPA563—our two novel anthrax vaccine candidates funded by the Biomedical Advanced Research and Development Authority (BARDA)**. Both vaccine candidates are prepared using the identical antigen and are being evaluated in parallel, although Px563L contains an adjuvant and RPA563 does not. In August 2016, we announced positive immunogenicity and safety data from Day 70 analysis of the Px563L and RPA563 anthrax vaccine study. The Px563L results indicated that the vaccine was well-tolerated and afforded immunogenicity protection with fewer doses than the currently licensed product. We announced positive interim results from a Phase 1a study in healthy subjects in the second half of 2016 and the study was completed in the first half of 2017. We have generated stability data on the 2016 manufactured lot for up to 12 months, demonstrating the maintenance of high purity at 5°C, the expected storage temperature, and accelerated stability data at 25°C. We have also generated long-term stability data from our toxicology lot, showing the maintenance of high purity at 5°C at 40 months. Over the course of 2018, we continued to collect favorable stability data for both products and also completed feasibility studies that demonstrated the compatibility of both products with the USP compendial relative potency method for anthrax. In addition, we completed adjuvant manufacturing optimization and bulk drug substance manufacturing process establishment runs at the commercial contract manufacturer. In October 2017, we completed a meeting with the FDA in which the FDA provided guidance for the proposed clinical development and licensure plans for a post-exposure prophylaxis indication. In 2017, BARDA exercised additional options under its existing contract, allowing for the continued development of Px563L and RPA563. One of the exercised options was increased by $1.7 million in May 2018, which increased the total contract value to $145.2 million. In September 2018, BARDA extended the contract period of performance.

  Potential next milestones are the triggering of analytical and non-clinical animal study options, leading to a potential Phase 1b/2 study in 2019, subject in each case to continued funding by BARDA. We believe the successful completion of the Phase 1b/2 study and activities under our development contract with BARDA could lead to a procurement contract for supply of Px563L or RPA563 to the Strategic National Stockpile.

- **CRM197**—We have both licenses and supply agreements in place for CRM197, which is a non-toxic mutant of diphtheria toxin. It is a well-characterized protein and functions as a carrier for polysaccharides and haptens, making them immunogenic. We developed a unique CRM197 production strain based on our *Pseudomonas fluorescens* platform and sell non-GMP and cGMP CRM197 to vaccine development-focused pharmaceutical partners. As a result of our development efforts, we previously entered into commercial licenses for production strains capable of producing CRM197 with

both Merck and SIIPL. Our CRM197 is currently being used in Merck's first Phase 3 clinical study of PCV-15 (V114), an investigational 15-valent polyvalent conjugate vaccine for the prevention of pneumococcal disease. This study was initiated in June 2018, at which time we earned a milestone payment. In addition, we are eligible to receive annual fees, milestone payments and a tiered royalty based on net sales for all products developed by Merck that use the CRM197 produced via the *Pf*ēnex Expression Technology platform. Our CRM197 is also currently being used by SIIPL, who is developing a 10-valent pneumococcal conjugate vaccine, Pneumosil. The SIIPL vaccine recently completed a Phase 3 study in which SIIPL reported that all primary and secondary objectives were met. This product is expected to enter in a Phase 3 study and is also targeted for developing countries. For both products we are eligible to receive a tiered royalty based upon net sales by SIIPL pursuant to regulatory approval. Our CRM197 is also being used in late-stage clinical trials for such diseases as pneumococcal and meningitis bacterial infections.

- **Additional Biosimilar Pipeline Products**—Our pipeline includes biosimilar candidates to certain reference products, including biosimilar candidates to Lucentis and Neulasta. Following our strategic review in November 2017, we decided to pause development activities on PF582, our biosimilar candidate to Lucentis and PF529, our biosimilar to Neulasta, and focus development efforts elsewhere within the product portfolio while we continue to engage potential strategic partners to advance the programs and maximize value.

To date, none of our product candidates have received marketing authorization from any regulatory agency. Therefore, we have not received revenue from the sale of any of our product candidates. Our product candidates are enabled by our patented protein production platform, *Pf*ēnex Expression Technology, which we believe confers several important competitive advantages compared to traditional techniques for protein production, including the ability to produce complex proteins with higher accuracy and greater degree of protein purity, as well as speed and cost advantages. The development of proteins requires several competencies which represent both challenges and barriers to entry. Due to their inherent complexity, proteins require the use of living organisms to efficiently produce them at a large scale. Traditional techniques for protein production employ a trial and error approach to production organism, or strain, selection and process optimization, which is inherently inefficient and typically produces suboptimal results. This historically inefficient process provides barriers to creating or replicating complex proteins, adds significant time to market and results in the high cost of goods typical of biologic therapeutics. Together, these limitations pose significant hurdles for companies interested in entering the market with novel biologics, biosimilars and therapeutic equivalents. Our platform utilizes a proprietary high throughput robotically-enabled parallel approach, which allows the construction and testing of thousands of unique protein production strains in parallel, thereby allowing us to produce and characterize complex proteins while reducing the time and cost of development and long-term production.

The potential market opportunities for our most advanced product candidate, PF708, are substantial. We have developed PF708 as a therapeutic equivalent candidate to Forteo, which achieved product sales of approximately $1.6 billion in 2018. Almost half of these product sales came from the U.S. alone. In 2019, Forteo is expected to lose patent protection with respect to claims of patents listed in the Orange Book related to compounds, methods of treatment, and formulations in the U.S. An additional Orange Book listed patent, which has claims relating to the delivery system, expires in 2025. It is not clear whether this patent will delay approval of PF708.

Our revenue for the three months ended December 31, 2018 and 2017 was $3.4 million and $17.9 million, respectively, and was $14.9 million and $28.8 million for the twelve months ended December 31, 2018 and 2017, respectively. Our historical revenue has been primarily derived from monetizing our *Pf*ēnex Expression Technology through collaboration agreements, service agreements, government contracts and reagent protein product sales, which provide for various types of payments, including upfront payments, funding of research and development, milestone payments, intellectual property access fees and licensing fees.

As of December 31, 2018, we had an accumulated deficit of $201.3 million, of which $89.8 million was attributable to recognizing the accretion in the redemption value of our convertible preferred stock. We recognized net losses of $6.8 million and $5.5 million for the three months ended December 31, 2018 and 2017, respectively, and $39.6 million and $25.7 million for the twelve months ended December 31, 2018 and 2017, respectively. As we continue to develop and invest more resources into the development and commercialization of our product candidates, our net operating losses will increase over the next several years. As a result, our research and development expenses will increase materially as we incur further costs of development. We currently utilize third-party clinical research organizations (CROs) to carry out our clinical development and we do not yet have an extensive sales organization. We will need substantial additional funding to support our operating activities, especially as we approach anticipated regulatory approval in the United States, Europe and other territories, and begin to establish our commercialization capabilities. Adequate funding may not be available to us on commercially reasonable terms, or at all. Since our inception, we have funded our operations primarily through the sale and issuance of common stock in our public offerings, revenue from our collaboration agreements, government contracts, service agreements, and reagent protein product sales, our prior credit facility and the private placement of equity securities. We have devoted substantially all of our capital resources to the research and development of our product candidates and working capital requirements.

Critical Accounting Policies, Significant Judgments and Use of Estimates

Our management's discussion and analysis of financial condition and results of operations is based on our consolidated financial statements, which have been prepared in accordance with accounting principles generally accepted in the United States (GAAP). The preparation of these financial statements requires us to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the financial statements, as well as the reported revenue and expenses during the reporting periods. These items are monitored and analyzed by us for changes in facts and circumstances, and material changes in these estimates could occur in the future. We base our estimates on historical experience and on various other factors that we believe are reasonable under the circumstances, the results of which form the basis for making judgments about the carrying value of assets and liabilities that are not readily apparent from other sources. Changes in estimates are reflected in reported results for the period in which they become known. Actual results may differ materially from these estimates under different assumptions or conditions. Historical results are not necessarily indicative of future results.

We believe the following critical accounting policies involve significant judgements and estimates used in the preparation of our consolidated financial statements (see also Note 1 to our consolidated financial statements included in Item 8 of this Annual Report on Form 10-K).

Revenues

In accordance with GAAP, we recognize revenue when all of the following criteria are met: (1) persuasive evidence of an arrangement exists; (2) delivery has occurred or services have been rendered; (3) the seller's price to the buyer is fixed or determinable; and (4) collectability is reasonably assured.

We consider a variety of factors in determining the appropriate method of accounting for our licensing and collaboration agreements, including whether multiple deliverables can be separated and accounted for individually as separate units of accounting. Where there are multiple deliverables within a collaboration agreement that cannot be separated and therefore are combined into a single unit of accounting, revenues are deferred and recognized over the estimated period of performance. If the deliverables can be separated, we apply the relevant revenue recognition guidance to each individual deliverable. The specific methodology for the recognition of the underlying revenue is determined on a case-by-case basis according to the facts and circumstances applicable to each agreement.

Upfront, nonrefundable licensing payments are assessed to determine whether or not the licensee is able to obtain standalone value from the license apart from the other deliverables in the arrangement. Where the license

does not have standalone value, non-refundable license fees are recorded as deferred revenue and recognized as revenue as we perform under the applicable agreement. Where the level of effort is relatively consistent over the performance period, we recognize fixed or determinable revenue on a straight-line basis over the estimated period of performance. Where the license has standalone value, we recognize total license revenue at the time all revenue recognition criteria have been met.

Nonrefundable payments for research funding are recognized as revenue over the period the underlying research activities are performed.

Upfront, nonrefundable payments for license fees, exclusivity and services received in excess of amounts earned are classified as deferred revenue and recognized as income over the contract term or period of performance based on the nature of the related agreement.

Revenue for our cost-plus fixed fee government contracts is recognized in accordance with the authoritative guidance for revenue recognition including the authoritative guidance specific to federal government contractors. Reimbursable costs under our government contracts primarily include direct labor, materials, subcontracts, accountable property and indirect costs. In addition, we receive a fixed fee under our government contracts, which is unconditionally earned as allowable costs are incurred and is not contingent on success factors. Reimbursable costs under our government contracts, including the fixed fee, are recognized as revenue in the period the reimbursable costs are incurred.

We assess milestone fees on an individual basis and recognize revenue from nonrefundable milestone fees when the earnings process is complete and the payment is reasonably assured. Nonrefundable milestone fees related to arrangements under which we have continuing performance obligations are recognized as revenue upon achievement of the associated milestone, provided that (i) the milestone event is substantive and its achievability was not reasonably assured at the inception of the agreement, and (ii) the amount of the milestone payment is reasonable in relation to the effort expended or the risk associated with the milestone event.

Preclinical and Clinical Trial Accruals

Our clinical trial accruals are based on estimates of patient enrollment and related costs at clinical investigator sites as well as estimates for the services received and efforts expended pursuant to contracts with multiple research institutions and CROs that conduct and manage clinical trials on our behalf.

We estimate preclinical and clinical trial expenses based on the services performed, pursuant to contracts with research institutions and clinical research organizations that conduct and manage preclinical studies and clinical trials on our behalf. In accruing service fees, we estimate the time period over which services will be performed and the level of patient enrollment and activity expended in each period. If the actual timing of the performance of services or the level of effort varies from the estimate, we will adjust the accrual accordingly. Payments made to third parties under these arrangements in advance of the receipt of the related series are recorded as prepaid expenses until the services are rendered.

Other Information

Income Tax Matters

On December 22, 2017, the U.S. government enacted comprehensive tax legislation referred to as the Tax Cuts and Jobs Act (the "Tax Act"). Shortly after the Tax Act was enacted, the SEC staff issued Staff Accounting Bulletin No. 118, Income Tax Accounting Implications of the Tax Cuts and Jobs Act (SAB 118), which provides guidance on accounting for the Tax Act's impact. SAB 118 provides a measurement period, which should not extend beyond one year from the Tax Act enactment date, during which a company acting in good faith may complete the accounting for the impacts of the Tax Act under ASC Topic 740. In accordance with SAB 118, the Company must reflect the income tax effects of the Tax Act in the reporting period in which the accounting under ASC Topic 740 is complete.

To the extent that our accounting for certain income tax effects of the Tax Act is incomplete, we can determine a reasonable estimate for those effects and record a provisional estimate in the consolidated financial statements in the first reporting period in which a reasonable estimate can be determined. If we cannot determine a provisional estimate to be included in the consolidated financial statements, we should continue to apply ASC 740 based on the provisions of the tax laws that were in effect immediately prior to the Tax Act being enacted. If we are unable to provide a reasonable estimate of the impacts of the Tax Act in a reporting period, a provisional amount must be recorded in the first reporting period in which a reasonable estimate can be determined. For further information, see Note 11 "Income Taxes" to our consolidated financial statements included in Item 8 of this Form 10-K.

During the year ended December 31, 2018, no tax provision was recorded. During the year ended December 31, 2017, we recorded an income tax benefit of $0.2 million each year, which is principally attributable to U.S. federal alternative minimum refundable tax credits and state income taxes. Our practice is to recognize interest and/or penalties related to income tax matters in income tax expense. We had no accrual for interest or penalties on our consolidated balance sheets at December 31, 2018 and 2017.

As of December 31, 2018, we had federal and state research and development credits carryforwards of approximately $6.6 million and $3.5 million, respectively, to offset potential tax liabilities. The federal research and development credits have a 20-year carryforward period and begin to expire in 2030 unless utilized. California research and development tax credits have no expiration. We have $79.9 million federal net operating loss carryforwards and $44.4 million of state net operating loss carryforwards as of December 31, 2018. Of the total federal net operating loss carryforwards, we have $38.4 million with no expiration which are available to offset up to 80% of federal taxable income in any given year. The remaining federal and state net operating losses can be carried forward until 2037 unless utilized.

We completed an IRC Section 382/383 analysis through December 31, 2014. We have not updated such Section 382 study through December 31, 2018. Future and current utilization of federal and state tax attribute carry-forwards may be limited, if, upon completion of our Section 382 study through December 31, 2018, we determine ownership changes within the meaning of Section 382 have occurred.

Results of Operations

Comparison of the years ended December 31, 2018, 2017, and 2016

The following table summarizes our net income (loss) during the periods indicated.

	Years Ended December 31,			% change from 2017 to 2018	% change from 2016 to 2017
	2018	2017	2016		
		(in thousands)			
Revenues	$ 14,857	$ 28,780	$60,194	(48)%	(52)%
Cost of revenues	5,022	5,156	5,313	(3)%	(3)%
Gross profit	9,835	23,624	54,881	(58)%	(57)%
Operating expenses					
Research and development	33,854	31,925	32,418	6%	(2)%
Selling, general and administrative	15,832	17,674	17,340	(10)%	2%
Total operating expense	49,686	49,599	49,758	0%	0%
(Loss) income from operations	(39,851)	(25,975)	5,123	(53)%	(607)%
Other income (expense)	258	119	149	117%	(20)%
Net (loss) income before income taxes	(39,593)	(25,856)	5,272	(53)%	(590)%
Income tax benefit	—	172	209	(100)%	(18)%
Net (loss) income	$(39,593)	$(25,684)	$ 5,481	(54)%	(569)%

Revenues

Revenue decreased by $13.9 million, or 48%, from $28.8 million in 2017 to $14.9 million in 2018. The change in revenue primarily resulted from $13.5 million in revenue recognized from a milestone payment from Jazz Pharmaceuticals in 2017. Additionally, our government contract with NIAID was completed at the end of 2017, contributing a further decrease in revenue.

Revenue decreased by $31.4 million, or 52%, from $60.2 million in 2016 to $28.8 million in 2017. The decrease in revenue was primarily due to the termination of our development and license agreement with Pfizer. In the third quarter of 2016, acceleration of the estimated performance period under the Pfizer contract resulted in the recognition of $45.8 million of revenue that had been previously deferred. In addition, in 2016 we recognized revenue of $4.9 million attributable to amortization of a development and license fee. The decrease in revenue was partially offset by $21.5 million of revenue recognized in 2017 from Jazz for development achievement and achievement of certain development milestones, development services and amortization of license fees.

Given the nature of the development process, revenue will fluctuate depending on stage of development.

Cost of Revenues

Cost of revenue decreased by $0.2 million, or 3%, to $5.0 million in 2018 compared to $5.2 million in 2017. The change was due primarily to a net decrease in costs related to our government contract with NIAID, as the program was completed at the end of 2017.

Cost of revenue decreased by $0.1 million, or 3%, to $5.2 million in 2017 compared to $5.3 million in 2016. The change was due primarily to a net decrease in costs for our proprietary novel vaccine program Px563L, which is funded by a government agency.

Research and Development

Research and development expenses increased by approximately $2.0 million, or 6%, to $33.9 million in 2018 compared to $31.9 million in 2017. The increase was primarily due to increased activity for PF708 to satisfy the clinical and manufacturing filing requirements for an NDA, which we submitted to the FDA in December of 2018. These increased costs were partially offset by a decrease in expenses due to our decision to pause our development activities on certain product candidates in the first half of 2017.

Research and development expenses decreased by approximately $0.5 million, or 2%, to $31.9 million in 2017 compared to $32.4 million in 2016. The decrease was primarily due to our decision to pause our development activities on certain product candidates. The decrease was partially offset by increased costs related to clinical trials for PF708, which began in the first quarter of 2017, and research and development expenses of PF743 and PF745 related to our collaboration with Jazz, as well as other biosimilar product candidates.

Our clinical trial accruals are based on estimates of patient enrollment and related costs at clinical investigator sites as well as estimates for the services received and efforts expended pursuant to contracts with multiple research institutions and clinical research organizations that conduct and manage clinical trials on our behalf.

We estimate preclinical and clinical trial expenses based on the services performed, pursuant to contracts with research institutions and clinical research organizations that conduct and manage preclinical studies and clinical trials on its behalf. In accruing service fees, we estimate the time period over which services will be performed and the level of patient enrollment and activity expended in each period. If the actual timing of the performance of services or the level of effort varies from the estimate, we adjust the accrual accordingly. Payments made to third parties under these arrangements in advance of the receipt of the related services are recorded as prepaid expenses until the services are rendered.

We expect research and development expenses to increase as we advance our lead candidates and pipeline product candidates. The funding necessary to bring a drug candidate to market is subject to numerous uncertainties. Once a drug candidate is identified, the further development of that drug candidate can be halted or abandoned at any time due to a number of factors. These factors include, but are not limited to, funding constraints, safety or a change in market demand. For each of our drug candidate programs, we periodically assess the scientific progress and merits of the programs to determine if continued research and development is economically viable. Certain of our programs may be terminated due to the lack of scientific progress and lack of prospects for ultimate commercialization.

Selling, General and Administrative

Selling, general and administrative expenses decreased by $1.8 million, or 10% to $15.8 million in 2018 compared to $17.7 million in 2017. The decrease was primarily due to higher expenditures related to legal and the separation for former officers in the first half of 2017.

Selling, general and administrative expenses increased by $0.3 million, or 2% to $17.7 million in 2017 compared to $17.3 million in 2016. The increase in selling, general and administrative was primarily due to costs incurred in connection with the separation of former officers.

To the extent that we retain commercial rights to product candidates, we intend to use an internal sales force to commercialize products for which we may receive marketing approvals. This would result in increased selling, general and administrative expenses.

Liquidity and Capital Resources

To date, we have funded our operations primarily through the sale and issuance of common stock in our public offerings, revenue from our collaboration agreements, government contracts, service agreements, and reagent protein product sales, our prior credit facility and the private placement of equity securities. At December 31, 2018, we had $56.2 million in cash and cash equivalents and $0.2 million in restricted cash as bank collateral for our commercial card program compared to $57.7 million in cash and cash equivalents as of December 31, 2017. We believe we have sufficient cash resources to meet our working capital and capital expenditures needs for the next 12 months from the date this Annual Report is filed with the SEC.

In July 2016, we entered into a development and license agreement with Jazz Pharmaceuticals for the development and commercialization of multiple early stage hematology/oncology product candidates, including PF743, a recombinant crisantaspase, and PF745, a recombinant crisantaspase with half-life extension technology, and in the third quarter of 2017, achieved a process development milestone. The agreement also includes an option for Jazz to negotiate a license for a recombinant pegaspargase product candidate with us. Under the terms of the agreement, we received an upfront and option payment totaling $15.0 million in July 2016 and may be eligible to receive additional payments based on the achievement of certain research and development, regulatory, and sales-related milestones.

In December 2017, we and Jazz entered into an amended and restated agreement, bringing the total value of payments and potential payments associated with the collaboration to $224.5 million. In addition, we may be eligible to receive tiered royalties on worldwide sales of any products resulting from the collaboration at rates reduced from those under the 2016 agreement.

We believe that our existing cash and cash equivalents and our cash inflow from operations will be sufficient to meet our anticipated cash needs for at least the next 12 months. We also believe we have sufficient cash resources to fund all necessary activities leading up to and including meeting our obligations to contractually support our partner on the potential commercial launch of PF708 in the United States as early as the fourth quarter 2019, subject to FDA approval of the new drug application and other factors We have based this

estimate on assumptions that may prove to be wrong, and we could utilize our available capital resources sooner than we currently expect. Further, our operating plan may change, and we may need additional funds to meet operational needs and capital requirements for product development and commercialization sooner than planned. We currently have no credit facility or committed sources of capital although we may receive milestone and other contingent payments under our current license and collaboration agreements. Because of the numerous risks and uncertainties associated with the development and commercialization of our product candidates and the extent to which we may enter into additional agreements with third parties to participate in their development and commercialization, we are unable to estimate the amounts of increased capital outlays and operating expenditures associated with our current and anticipated clinical trials. Our future capital requirements will depend on many factors, including:

- the timing and extent of spending on our research and development efforts, including with respect to PF708 and our other product candidates;
- our ability to enter into and maintain collaboration, licensing, commercialization and other arrangements and the terms and timing of such arrangements;
- the timing of the marketing approval for PF708, if any;
- the cost to us of development, manufacturing and commercialization activities for PF708 and our other product candidates, if any;
- the cost of preparing, filing, prosecuting, defending and enforcing any patent claims and other intellectual property rights;
- the receipt of any collaboration or milestone payments;
- the scope, rate of progress, results and cost of our clinical trials, preclinical testing and other related activities;
- the emergence of competing technologies or other adverse market developments;
- the time and costs involved in seeking and obtaining regulatory and marketing approvals in multiple jurisdictions for our product candidates that successfully complete clinical trials;
- the introduction of new product candidates and the number and characteristics of product candidates that we pursue;
- the timing, receipt and amount of sales, profit sharing or royalties, if any, from our potential products;
- the degree and rate of market acceptance of any products launched by us or our collaboration partner;
- the expansion of our sales and marketing activities; and
- the potential acquisition and in-licensing of other technologies, products or assets.

We will need to raise additional capital to fund our operations in the near future. Funding may not be available to us on acceptable terms, or at all. If we are unable to obtain adequate financing when needed, we may have to delay, reduce the scope of or suspend one or more of our clinical trials, research and development programs or commercialization efforts. We may seek to raise any necessary additional capital through a combination of public or private equity offerings, debt financings, collaborations, strategic alliances, licensing arrangements and other marketing and distribution arrangements. To the extent that we raise additional capital through marketing and distribution arrangements or other collaborations, strategic alliances or licensing arrangements with third parties, we may have to relinquish valuable rights to our product candidates, future revenue streams, research programs or product candidates or to grant licenses on terms that may not be favorable to us. If we do raise additional capital through public or private equity offerings, the ownership interest of our existing stockholders will be diluted, and the terms of these securities may include liquidation or other preferences that adversely affect our stockholders' rights. If we raise additional capital through debt financing, we may be subject to covenants limiting or restricting our ability to take specific actions, such as incurring additional debt, making capital expenditures or declaring dividends.

Cash Flows

The following table sets forth the primary sources and uses of cash, cash equivalents and restricted cash for each of the periods presented below.

	Years Ended December 31,		
	2018	2017	2016
		(in thousands)	
Net cash (used in) provided by:			
Operating activities	$(39,428)	$(21,510)	$(22,274)
Investing activities	(1,472)	(2,197)	(2,860)
Financing activities	39,456	70	(3,486)
Net decrease in cash, cash equivalents and restricted cash	$ (1,444)	$(23,637)	$(28,620)

Net cash used in operating activities

Net cash used in operating activities was $39.4 million for the year ended December 31, 2018. Net cash used was primarily attributable to our research and development activities associated with PF708 and our other product candidates.

Net cash used in operating activities was $21.5 million for the year ended December 31, 2017. Net cash used was primarily attributable to our research and development activities associated with PF708 and our other product candidates, partially offset by $18.5 million of payments received pursuant to our agreement with Jazz.

Net cash used in operating activities was $22.3 million for the year ended December 31, 2016, which was primarily attributable to our research and development activities associated with PF708 and our other product candidates. This was partially offset by $15.0 million of upfront and option payments received pursuant to our license and option agreement with Jazz. In addition, our general and administrative costs increased due to higher headcount and marketing and legal expenses.

We anticipate using cash in operating activities for our research and development efforts for the foreseeable future.

Net cash used in investing activities

Net cash used in investing activities was $1.5 million, $2.2 million and $2.9 million for the years ended December 31, 2018, 2017 and 2016, respectively, and was due primarily to the purchase of property and equipment.

Net cash (used in) provided by financing activities

Net cash provided by financing activities in 2018 was primarily related to the net proceeds of approximately $39.5 million from the issuance of our common stock in connection with our follow-on offering after deducting offering expenses.

Net cash provided by financing activities was $0.1 million for the year ended December 31, 2017, which was primarily due to $0.2 million in proceeds from the issuance of common stock in connection with our Employee Stock Purchase Plan and exercises of stock options. This was partially offset by $0.1 million used to repay capital lease obligations.

Net cash used in financing activities was $3.5 million for the year ended December 31, 2016. This resulted primarily from the $3.8 million repayment of the Amended Credit Facility upon termination in February 2016.

Off-Balance Sheet Arrangements

In the normal course of business, we enter into contracts and agreements that contain a variety of representations and warranties and provide for general indemnifications. Our exposure under these agreements is unknown because it involves claims that may be made against us in the future but have not yet been made. As of December 31, 2018, we have not paid any claims or been required to defend any action related to our indemnification obligations. However, we may record charges in the future as a result of these indemnification obligations.

Contractual Obligations and Commitments

The following summarizes our contractual obligations and commitments as of December 31, 2018:

	Payments due by period				
Contractual Obligations (*in thousands*)	**Total**	**Less than 1 year**	**1 - 3 years**	**3 - 5 years**	**More than 5 years**
Purchase obligations	$ 6,395	$6,395	$ —	$ —	$ —
Operating lease obligations[1]	4,849	901	2,742	1,206	—
Capital lease obligations[2]	542	344	198	—	—
	$11,786	$7,640	$2,940	$1,206	$ —

(1) Operating lease obligations are primarily rent payments on our facility leases.
(2) Capital lease obligations consist mainly of capital leases on lab equipment.

In June 2010, we entered into a lease agreement (Lease) with a landlord for an initial term of 10 years, for our corporate headquarters comprised of one building located in San Diego, California. Occupation of the premises under the Lease began in April 2011. Under the terms of the Lease, we pay annual base rent, subject to an annual fixed percentage increase, plus our share of common operating expenses. The annual base rent was subject to abatement of 50% for the first year of the lease. We recognize rent expense on a straight-line basis over the term of the Lease. Total rent payments over the life of the Lease was estimated to be $3.6 million.

In September 2014, we amended the Lease to extend the term for an additional three years through June 30, 2024 and to lease additional facilities consisting of 7,315 square feet, resulting in a total increase in the estimated rent payments over the life of the Lease by approximately $2.9 million. Base rent payments for the new space commenced in December 2014 and increased total estimated rent payments over the life of the Lease by approximately $1.5 million. The extended term on the existing space increased total estimated rent payments by approximately $1.4 million. In addition to the base rent, we are obligated to pay certain customary amounts for our share of operating expenses and tax obligations. In November 2015, we amended the Lease to add facilities consisting of 16,811 square feet. Base rent payments for a portion of the new space commenced in March 2016, which increased total estimated rent payments over the life of the lease by approximately $2.3 million. In January 2017, a sublease agreement was executed with a tenant to lease a portion of leased space from us. The sublease terminated in 2018. The amounts received were offset against rent expense.

In March 2016, we entered into an operating lease for lab equipment with estimated total payments of $0.7 million over the two-year term.

In June 2017, we signed master lease agreements for the purchase of specialized equipment totaling approximately $0.8 million. The capital leases each have a term of 36 months and commenced during the quarter ending September 30, 2017.

We enter into contracts in the normal course of business with contract research organizations and subcontractors to further develop our products. The contracts are cancellable, with varying provisions regarding termination. If a contract with a specific vendor were to be terminated, we would only be obligated for products or services that we had received as of the effective date of the termination and any applicable cancellation fees.

Recently Issued Accounting Pronouncements

In May 2014, the Financial Accounting Standards Board (FASB) issued Accounting Standards Update (ASU) No. 2014-09, *Revenue from Contracts with Customers (Topic 606)*, which supersedes the revenue recognition requirements in ASC 605, Revenue Recognition. This ASU is based on the principle that revenue is recognized to depict the transfer of goods or services to customers in an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services. The ASU also requires additional disclosure about the nature, amount, timing and uncertainty of revenue and cash flows arising from customer contracts, including significant judgments and changes in judgments and assets recognized from costs incurred to obtain or fulfill a contract. Numerous updates were issued in 2016 that provide clarification on a number of specific issues as well as requiring additional disclosures. The effective date is our annual fiscal year 2019 and interim periods thereafter, using one of two retrospective application methods: the full retrospective method or the modified retrospective method. We plan to adopt the standard in fiscal year 2019 using the modified retrospective method. We do not expect the new standard to have a material impact on the recognition of revenue from our reagent protein product sales. We are currently evaluating the impact of the new standard on historical revenue recorded for our collaboration agreements. This ongoing evaluation is dependent upon the resolution of certain questions relating to the application of the new revenue recognition guidance for collaboration agreements which will ultimately determine the impact, if any, the adoption of this standard may have on the consolidated financial statements.

In February 2016, the FASB issued ASU No. 2016-02 Leases (Topic 842), which was subsequently amended in July 2018 by ASU No. 2018-10, *Codification Improvements to Topic 842, Leases* and ASU No. 2018-11, *Leases (Topic 842): Targeted Improvements*. This ASU increases transparency and comparability by recognizing a lessee's rights and obligations resulting from leases by recording them on the balance sheet as right-of-use assets and lease liabilities. The new standard requires lessees to apply a dual approach, classifying leases as either finance or operating leases based on the principle of whether or not the lease is effectively a financed purchase by the lessee.

This classification dictates whether lease expense is to be recognized based on an effective interest method or on a straight-line basis over the term of the lease. Additional qualitative and quantitative disclosures will be required to give financial statement users information on the amount, timing and judgments related to a reporting entity's cash flows arising from leases. This guidance is effective for us in our annual fiscal year 2020 and interim periods thereafter. We are currently evaluating the impact of the adoption of this accounting standard update on our consolidated financial statements.

In January 2017, the FASB issued ASU No. 2017-04, *Intangibles—Goodwill and Other (Topic 350): Simplifying the Test for Goodwill Impairment.* This updated guidance eliminates Step 2 from the current two-step quantitative model for goodwill impairment tests. Step 2 required an entity to calculate an implied fair value, which included a hypothetical purchase price allocation requirement, for reporting units that failed Step 1. Per this updated guidance, a goodwill impairment will instead be measured as the amount by which a reporting unit's carrying value exceeds its fair value as identified in Step 1. This guidance is effective for fiscal years beginning after December 15, 2019, including interim periods within that reporting period. Early adoption is permitted for interim or annual goodwill impairment tests performed on testing dates after January 1, 2017. The adoption of this guidance is not expected to have a material impact on our consolidated financial statements.

In June 2018, the FASB issued ASU No. 2018-07, *Compensation-Stock Compensation (Topic 718)*, which simplifies the accounting for nonemployee share-based payment transactions. The amendments specify that Topic 718 applies to all share-based payment transactions in which a grantor acquires goods or services to be used or consumed in a grantor's own operations by issuing share-based payment awards. The standard will be effective for us in the first quarter of fiscal year 2020, although early adoption is permitted (but no sooner than the adoption of Topic 606). The adoption of this guidance is not expected to have a material impact on the consolidated financial statements.

In August 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. This new guidance aligns the requirements for capitalizing implementation costs incurred in a hosting arrangement that is a service contract with the requirements for capitalizing implementation costs incurred to develop or obtain internal-use software. ASU 2018-15 is effective for us beginning in the first quarter of fiscal year 2020, with early adoption permitted. We are currently evaluating this guidance to determine the impact on our financial statements and related disclosures.

In November 2018, the FASB issued ASU No. 2018-18, *Collaborative Arrangements (Topic 808)—Clarifying the Interaction between Topic 808 and Topic 606*. The amendments in ASU No. 2018-18 make targeted improvements to generally accepted accounting principles for collaborative arrangements by clarifying that certain transactions between collaborative arrangement participants should be accounted for as revenue under Accounting Standard Codification 606, *Revenue from Contracts with Customers*, or ASC 606, when the collaborative arrangement participant is a customer in the context of a unit of account. In those situations, all the guidance in ASC 606 should be applied, including recognition, measurement, presentation, and disclosure requirements. In addition, unit-of-account guidance in ASC 808 was aligned with the guidance in ASC 606 when an entity is assessing whether the collaborative arrangement or a part of the arrangement is within the scope of ASC 606. ASU No. 2018-18 is effective for fiscal years beginning after December 15, 2019, and interim periods within those fiscal years. Early adoption is permitted, including adoption in any interim period. The amendments in ASU No. 2018-18 are required to be applied retrospectively to the date of initial application of ASC 606. We are currently evaluating the impact of ASU No. 2018-08 on our consolidated financial statements.

Item 7A. *Quantitative and Qualitative Disclosures about Market Risk*

We are exposed to market risk in the ordinary course of our business. Market risk represents the risk of loss that may impact our financial position due to adverse changes in financial market prices and rates. Our market risk exposure is primarily a result of fluctuations in interest rates and foreign currency exchange rates. As of December 31, 2018, we did not hold or issue financial instruments for trading purposes.

Interest rate fluctuation risk

The primary objective of our investment activities is to preserve our capital to fund our operations. We also seek to maximize income from our cash and cash equivalents without assuming significant risk. To achieve our objectives, we invest our cash and cash equivalents in money market funds, treasury obligations, short term certificates of deposit and high-grade corporate securities, directly or through managed funds, with maturities of six months or less. As of December 31, 2018, we had cash and cash equivalents of $56.2 million consisting of cash of $11.5 million and investments of $44.7 million in highly liquid U.S. money market funds. A portion of our investments may be subject to interest rate risk and could fall in value if market interest rates increase. However, because our investments are primarily short-term in duration, we believe that our exposure to interest rate risk is not significant and a 100 basis point movement in market interest rates would not have a significant impact on the total value of our portfolio. We actively monitor changes in interest rates.

Foreign currency exchange risk

We contract with clinical research organizations, investigational sites and suppliers in foreign countries. We are therefore subject to fluctuations in foreign currency rates in connection with these agreements. We have not entered into any material foreign currency hedging contracts although we may do so in the future. To date we have not incurred any material effects from foreign currency changes on these contracts. The effect of a 10% adverse change in exchange rates on foreign currency denominated cash and payables as of December 31, 2018 would not have been material. However, fluctuations in currency exchange rates could harm our business in the future.

Inflation risk

Inflation may affect us by increasing our cost of labor and clinical trial costs. We do not believe that inflation has had a material effect on our business, financial condition or results of operations for any period presented herein.

Item 8. ***Financial Statements and Supplementary Data***

INDEX TO FINANCIAL STATEMENTS

Report of Independent Registered Public Accounting Firm

To the Stockholders and Board of Directors
Pfenex Inc.:

Opinion on the Consolidated Financial Statements

We have audited the accompanying consolidated balance sheets of Pfenex Inc. and subsidiaries (the Company) as of December 31, 2018 and 2017, the related consolidated statements of operations, changes in stockholders' equity, and cash flows for each of the years in the three-year period ended December 31, 2018, and the related notes (and financial statement schedule II) (collectively, the consolidated financial statements). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2018 and 2017, and the results of its operations and its cash flows for each of the years in the three-year period ended December 31, 2018, in conformity with U.S. generally accepted accounting principles.

Basis for Opinion

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

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the consolidated financial statements are free of material misstatement, whether due to error or fraud. The Company is not required to have, nor were we engaged to perform, an audit of its internal control over financial reporting. As part of our audits, we are required to obtain an understanding of internal control over financial reporting but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control over financial reporting. Accordingly, we express no such opinion.

Our audits included performing procedures to assess the risks of material misstatement of the consolidated 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 consolidated financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the consolidated financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ KPMG LLP

We have served as the Company's auditor since 2016.

San Diego, California
March 11, 2019

PFENEX INC.

Consolidated Balance Sheets

	December 31,	
	2018	2017
	(in thousands)	
Assets		
Current assets		
Cash and cash equivalents	$ 56,220	$ 57,664
Restricted cash	200	200
Accounts and unbilled receivables, net	5,171	1,306
Income tax receivable	207	638
Other current assets	1,851	1,705
Total current assets	63,649	61,513
Property and equipment, net	7,671	7,397
Other long-term assets	133	133
Intangible assets, net	4,248	4,771
Goodwill	5,577	5,577
Total assets	$ 81,278	$ 79,391
Liabilities and Stockholders' Equity		
Current liabilities		
Accounts payable	$ 2,005	$ 1,905
Accrued liabilities	9,812	8,913
Current portion of deferred revenue	5,317	7,421
Current portion of capital lease obligations	316	228
Total current liabilities	17,450	18,467
Deferred revenue, less current portion	2,500	2,742
Capital lease obligations, less current portion	191	419
Total liabilities	20,141	21,628
Commitments and contingencies		
Stockholders' equity		
Preferred stock, $0.001 par value, 10,000,000 shares authorized; no shares issued and outstanding	—	—
Common stock, par value $0.001, 200,000,000 shares authorized at December 31, 2018 and 2017, respectively, 31,467,580 and 23,548,280 shares issued and outstanding at December 31, 2018 and 2017, respectively	32	24
Additional paid-in capital	262,405	219,446
Accumulated deficit	(201,300)	(161,707)
Total stockholders' equity	61,137	57,763
Total liabilities and stockholders' equity	$ 81,278	$ 79,391

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

PFENEX INC.

Consolidated Statements of Operations

	Years Ended December 31,		
	2018	**2017**	**2016**
	(in thousands except for per share data)		
Revenue	$ 14,857	$ 28,780	$60,194
Cost of revenue	5,022	5,156	5,313
Gross profit	9,835	23,624	54,881
Operating expense			
Research and development	33,854	31,925	32,418
Selling, general and administrative	15,832	17,674	17,340
Total operating expense	49,686	49,599	49,758
(Loss) income from operations	(39,851)	(25,975)	5,123
Other income, net	258	119	149
Net (loss) income before income taxes	(39,593)	(25,856)	5,272
Income tax benefit	—	172	209
Net (loss) income	$(39,593)	$(25,684)	$ 5,481
Net (loss) income per common share, basic and diluted	$ (1.40)	$ (1.09)	$ 0.23
Weighted-average common shares used to compute net (loss) income per share			
Basic	28,340	23,503	23,389
Diluted	28,340	23,503	23,688

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

PFENEX INC.

Consolidated Statements of Changes in Stockholders' Equity
(in thousands)

	Common Stock		Additional Paid in Capital	Accumulated Deficit	Total Stockholders' Equity
	Shares	Amount			
Balance at December 31, 2015	23,316	$ 24	$212,661	$(141,504)	$ 71,181
Exercise of stock options	78	—	123	—	123
Issuance of common stock under employee stock purchase plan	36	—	204	—	204
Stock-based compensation expense	—	—	3,156	—	3,156
Net income	—	—	—	5,481	5,481
Balance at December 31, 2016	23,430	$ 24	$216,144	$(136,023)	$ 80,145
Exercise of stock options	85	—	26	—	26
Issuance of common stock under employee stock purchase plan	33	—	153	—	153
Stock-based compensation expense	—	—	3,123	—	3,123
Net loss	—	—	—	(25,684)	(25,684)
Balance at December 31, 2017	23,548	$ 24	$219,446	$(161,707)	$ 57,763
Restricted stock units	17	—	57	—	57
Exercise of stock options	44	—	94	—	94
Issuance of common stock under employee stock purchase plan	39	—	115	—	115
Stock-based compensation expense	—	—	3,179	—	3,179
Issuance of common stock, net of discount and offering costs	7,820	8	39,514	—	39,522
Net loss	—	—	—	(39,593)	(39,593)
Balance at December 31, 2018	31,468	$ 32	$262,405	$(201,300)	$ 61,137

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

PFENEX INC.

Consolidated Statements of Cash Flows

	Years Ended December 31,		
	2018	2017	2016
		(in thousands)	
Cash flows from operating activities			
Net (loss) income	$(39,593)	$(25,684)	$ 5,481
Adjustments to reconcile net (loss) income to net cash used in operating activities:			
Depreciation and amortization	1,148	876	670
Amortization of intangible assets	532	530	531
Deferred income taxes	—	—	1,955
Stock-based compensation expense	3,179	3,123	3,156
Loss/(Gain) on disposal of property and equipment	8	(20)	250
Changes in operating assets and liabilities			
Accounts and unbilled receivables	(3,865)	1,516	(139)
Other current assets	(147)	173	(160)
Other long-term assets	—	(53)	25
Accounts payable	68	628	431
Accrued liabilities	1,157	(585)	3,250
Deferred revenue	(2,346)	(2,092)	(35,840)
Income tax receivable	431	78	(1,884)
Net cash used in operating activities	(39,428)	(21,510)	(22,274)
Cash flows from investing activities			
Acquisitions of property and equipment	(1,472)	(2,242)	(2,868)
Proceeds from sales of equipment	—	45	8
Net cash used in investing activities	(1,472)	(2,197)	(2,860)
Cash flows from financing activities			
Proceeds from issuance of common stock, net of underwriters' fees	39,999	—	—
Payments for offering costs	(477)	—	—
Repayments of borrowings under line of credit agreement	—	—	(3,813)
Repayments of capital lease obligations	(238)	(109)	—
Proceeds from exercise of stock options and other stock issuances	210	179	327
Payment for taxes related to net share settlement of equity awards	(38)	—	—
Net cash provided by (used in) financing activities	39,456	70	(3,486)
Net decrease in cash, cash equivalents and restricted cash	(1,444)	(23,637)	(28,620)
Cash, cash equivalents and restricted cash			
Beginning of year	57,864	81,501	110,121
End of year	$ 56,420	$ 57,864	$ 81,501
Supplemental schedule of cash flow information			
Cash paid for interest	$ 41	$ 22	$ 30
Cash paid for taxes	$ 48	$ —	$ 32
Non-cash financing and investing transactions			
Acquisitions under capital lease obligations	$ 98	$ 676	$ 42
Restricted stock issuance for bonus payment	$ 57	$ —	$ —
Asset acquisitions in accounts payable and accrued expenses	$ 210	$ 361	$ 248

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

PFENEX INC.

Notes to Consolidated Financial Statements

1. Organization and Summary of Significant Accounting Policies

Business Activities and Organization

Pfenex Inc. (the Company or Pfenex) is a clinical-stage development and licensing biotechnology company focused on leveraging its *Pf*ēnex Expression Technology® to develop and improve protein therapies for unmet patient needs. Using the patented *Pf*ēnex Expression Technology platform, the Company has created an advanced pipeline of therapeutic equivalents, vaccines, biologics and biosimilars. The Company also uses its *Pf*ēnex Expression Technology platform to produce CRM197, a diphtheria toxoid carrier protein used in prophylactic and therapeutic vaccines. The Company's lead product candidates are PF708, a therapeutic equivalent candidate to Forteo® (teriparatide) for the treatment of osteoporosis, and its novel anthrax vaccine candidates, Px563L and RPA563, funded through an advanced development contract with the U.S. government. In December 2018, the Company submitted its new drug application (NDA) for Forteo to the FDA and the FDA accepted the submission for substantive review in February 2019. In April 2018, the Company granted certain development and commercialization rights for PF708 in certain Asian countries to China NT Pharma Group Company Limited (NT Pharma). In June 2018, the Company granted Alvogen Malta Operations Ltd. (Alvogen) exclusive rights to commercialize and manufacture PF708 in the United States. In February 2019, the Company expanded those rights to Alvogen to include the EU, certain countries in the Middle East and North Africa and to the ROW territories (excluding certain Asian countries granted to NT Pharma). In addition, the Company is developing hematology/oncology products in collaboration with Jazz Pharmaceuticals Ireland Limited (Jazz). Furthermore, the Company's pipeline includes biosimilar candidates to Lucentis ® and Neulasta®.

Proposed Therapeutic Equivalent: PF708—Teriparatide

PF708 is being developed as a therapeutic equivalent candidate to Forteo, which is approved and marketed by Eli Lilly and Company for the treatment of osteoporosis patients at a high risk of fracture. In April 2018, the Company and NT Pharma entered into a Development and License Agreement (NT Pharma Agreement), pursuant to which the Company granted an exclusive license to NT Pharma to commercialize PF708 in Mainland China, Hong Kong, Singapore, Malaysia and Thailand and a non-exclusive license to conduct development activities in such territories with respect to PF708. The Company will be responsible for commercial manufacturing and will provide NT Pharma with the product for commercial sale. NT Pharma will be responsible for all regulatory submissions, development costs and costs associated with regulatory approvals in such territories. In June 2018, the Company and Alvogen entered into a Development and License Agreement (Alvogen Agreement) pursuant to which Alvogen has the exclusive right to commercialize and manufacture PF708 in the United States. The Company will continue to be responsible for development and registration of PF708 in the US, while Alvogen will provide regulatory and development expertise. In February 2019, the Company and Alvogen entered into additional agreements, extending Alvogen's rights to commercialize and manufacture PF708 to include the EU, certain countries in the Middle East and North Africa and to the ROW territories (excluding certain Asian countries granted to NT Pharma). Alvogen is responsible for local activities and for overseeing any clinical development, regulatory, litigation, commercial manufacturing and commercialization.

Collaboration Partner: Jazz Pharmaceuticals Ireland Limited

In July 2016, the Company and Jazz announced an agreement under which the Company granted Jazz worldwide rights to develop and commercialize multiple early stage hematology/oncology product candidates, including PF743, a recombinant crisantaspase, and PF745, a recombinant crisantaspase with half-life extension technology. In December 2017, the parties amended the Jazz agreement, bringing the total value of payments and potential payments associated with the collaboration to $224.5 million. In addition, the Company may be eligible

to receive tiered royalties on worldwide sales of any products resulting from the collaboration at rates reduced from those under the 2016 agreement.

Novel Vaccines: **Px563L and RPA563—rPA based anthrax vaccines**

The Company is also developing Px563L and RPA563, novel anthrax vaccine candidates, in response to the United States government's unmet demand for increased quantity, stability and dose-sparing regimens of anthrax vaccine. The government contract is funded by the Biomedical Advanced Research and Development Authority (BARDA). The Company had initially entered into a development contract with BARDA in 2010. The $25.2 million fully-funded contract was completed in 2015, at which time BARDA awarded the Company a cost-plus fixed fee advanced development contract valued at up to approximately $143.5 million. In January 2017, BARDA exercised two options under its existing contract for further development of Px563L and RPA563. One of the exercised options was increased by $1.7 million in May 2018, which increased the total contract value to $145.2 million. In September 2018, BARDA extended the contract period of performance to December 2019.

Pfēnex Expression Technology Licenses: **CRM197**

The Company has several development and commercial partnerships in place for CRM197, which is a non-toxic mutant of diphtheria toxin. It is a well-characterized protein and functions as a carrier for polysaccharides and haptens, making them immunogenic. The Company developed a unique CRM197 production strain based on its *Pseudomonas fluorescens* platform and sells non-GMP and cGMP CRM197 to vaccine development-focused pharmaceutical partners. As a result of those efforts, the Company previously entered into commercial licenses for production strains capable of producing CRM197 with both Merck & Co., Inc. (Merck) and Serum Institute of India Private, Ltd (SIIPL). These commercial license agreements with Merck and SIIPL contemplate potential maintenance and milestone fees as well as royalties on net sales. Merck and SIIPL are currently using the Company's CRM197 in multiple Phase 3 clinical trials for such diseases as pneumococcal and meningitis bacterial infections.

The Company expects revenue in the near term to be primarily related to monetizing its protein production platform through CRM197 product sales, commercial license agreements, service agreements, and government contracts, which may provide for various types of payments, including upfront payments, funding of research and development, milestone payments, intellectual property access fees and licensing fees.

Other Pipeline Products

In addition to the Company's lead product candidates, its pipeline includes various other biosimilar candidates, including PF582, the Company's biosimilar candidate to Lucentis, and PF529, the Company's biosimilar candidate to Neulasta, as well as vaccines and next generation biologic candidates. Following its strategic review in November 2017, the Company decided to pause its development activities for PF582 and PF529 and focus the Company's efforts and resources elsewhere in its product portfolio.

At the Market Offering Program

In March 2018, the Company entered into an equity sales agreement (Sales Agreement) with William Blair & Company, L.L.C. (William Blair) to sell shares of the Company's common stock having aggregate sales proceeds of up to $20.0 million, from time to time, through an "at the market" equity offering program under which William Blair will act as sales agent. Under the Sales Agreement, the Company sets the parameters for the sale of shares, including the number of shares to be issued, the time period during which sales are requested to be made, limitation on the number of shares that may be sold in any one trading day and any minimum price below which sales may not be made. As of December 31, 2018, the Company had not sold any shares under the Sales Agreement.

Follow-on Public Offering

In May 2018, the Company completed a public offering of common stock in which it sold 7,820,000 shares of its common stock at an offering price of $5.50 per share, which included the full exercise by the underwriters of their option to purchase an additional 1,020,000 shares, pursuant to the Company's existing shelf registration statement. The net proceeds generated from this transaction, after underwriting discounts and commissions and offering costs, were approximately $39.5 million.

Basis of Presentation

The accompanying consolidated financial statements have been prepared in accordance with United States generally accepted accounting principles (U.S. GAAP), and reflect all of the Company's activities, including those of its wholly-owned subsidiary. All material intercompany accounts and transactions have been eliminated in consolidation. In the opinion of management, all adjustments considered necessary for a fair presentation have been included. These adjustments consist of normal and recurring accruals, as well as non-recurring charges.

Use of Estimates

The preparation of the accompanying consolidated financial statements in conformity with U.S. GAAP requires management to make estimates and assumptions that affect the reported amounts (including assets, liabilities, revenues and expenses) and related disclosures. Estimates have been prepared on the basis of the most current and best available information. However, actual results could differ from those estimates.

Risk and Uncertainties

The Company's future results of operations involve a number of risks and uncertainties. Factors that could affect the Company's future operating results and cause actual results to vary materially from expectations include, but are not limited to, uncertainty of results of clinical trials and reaching milestones, uncertainty of regulatory approval of the Company's product candidates, uncertainty of market acceptance of the Company's products if approved for sale, competition from substitute products and larger companies, securing and protecting proprietary technology, strategic relationships and dependence on key individuals.

Products developed by the Company require clearances from international and domestic regulatory agencies prior to commercial sales in such jurisdictions. There can be no assurance that the products will receive the necessary clearances. If the Company was denied clearance, clearance was delayed or the Company was unable to maintain clearance, it could have a materially adverse impact on the Company.

As of December 31, 2018, the Company had an accumulated deficit of $201.3 million and expects to incur substantial operating losses for the next several years. The Company believes that its existing cash and cash equivalents and cash inflow from operations will be sufficient to meet its anticipated cash needs for at least the next 12 months from the date these consolidated financial statements are issued, including all necessary activities leading up to and including meeting our obligations to contractually support our partner on the potential commercial launch of PF708 in the United States as early as the fourth quarter of 2019, subject to FDA approval of the new drug application and other factors.

The Company will require substantial cash to achieve its objectives of discovering, developing and commercializing drugs, as this process typically takes many years and potentially hundreds of millions of dollars for an individual drug. The Company may not have adequate available cash, or assets that could be readily turned into cash, to meet these objectives in the long term. It will need to obtain significant funds under its existing collaborations and license agreements, under new collaboration, licensing or other commercial agreements for one or more of its drug candidates and programs or patent portfolios, or from other potential sources of liquidity, which may include the sale of equity, issuance of debt or other transactions. However, there can be no assurance

that any additional financing or strategic investments will be available to the Company on acceptable terms, if at all. If events or circumstances occur such that it does not obtain additional funding, the Company will most likely be required to reduce its plans and/or certain discretionary spending, which could have a material adverse effect on its ability to achieve its intended business objectives.

Cash and Cash Equivalents

The Company considers all highly liquid investments that are readily convertible into cash and have an original maturity of 90 days or less at the time of purchase to be cash equivalents. Cash amounts that are restricted as to withdrawal or usage are presented as restricted cash. In January 2017, the Company entered into a Borrower's Pledge Agreement, which required $0.2 million in restricted cash to be provided as security for its commercial credit card arrangement with one of the Company's banks.

Concentrations

Financial instruments that potentially subject the Company to concentrations of credit risk consist primarily of cash, cash equivalents, investments and accounts and unbilled receivables. The Company has established guidelines intended to limit its exposure to credit risk by placing investments with high credit quality financial institutions, diversifying its investment portfolio and placing investments with maturities that help maintain safety and liquidity. All cash and cash equivalents were held at three major financial institutions as of December 31, 2018. For the Company's cash position of $56.4 million as of December 31, 2018, which included restricted cash of $0.2 million, the Company has exposure to credit loss for amounts in excess of insured limits in the event of non-performance by the institutions; however, the Company does not anticipate non-performance.

Additional credit risk is related to the Company's concentration of receivables. As of December 31, 2018 and 2017, receivables were concentrated among three customers representing 87% and 89% of total net receivables, respectively. No allowance for doubtful accounts was recorded at December 31, 2018 or 2017. For the years ended December 31, 2018 and 2017, revenue was concentrated among two customers and/or collaboration partners representing 87% and 94% of total revenues, respectively. One collaboration partner represented 80% of total revenue for the year ended December 31, 2016.

A portion of revenue is earned from sales outside the United States. Non-U.S. revenue is denominated in U.S. dollars. A breakdown of the Company's revenue from U.S. and non-U.S. sources for the years ended December 31, 2018, 2017 and 2016 is as follows:

	Years Ended December 31,		
	2018	2017	2016
		(in thousands)	
US revenue	$ 5,083	$ 6,477	$54,641
Non-US revenue	9,774	22,303	5,553
Total revenue	$14,857	$28,780	$60,194

During the years ended December 31, 2018 and 2017, Ireland accounted for more than 10% of the Company's revenue. For the year ended December 31, 2016, no single foreign country accounted for more than 10% of the Company's revenues.

Fair Value of Financial Instruments

Financial instruments, including cash, cash equivalents, restricted cash and the lines of credit, are carried at cost, which management believes approximates fair value because of the short-term maturity of these instruments.

Fair value is an exit price, representing the amount that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants. As such, fair value is a market-based measurement that should be determined based on assumptions that market participants would use in pricing an asset or liability. As a basis for considering such assumptions, a three-tier fair value hierarchy has been established, which prioritizes the inputs used in measuring fair value as follows:

- Level 1—Observable inputs such as quoted prices in active markets for identical assets or liabilities. Level 1 assets at December 31, 2018 and December 31, 2017 included the Company's cash, cash equivalents and restricted cash. There were no Level 1 liabilities;
- Level 2—Inputs, other than the quoted prices in active markets, that are observable either directly or indirectly. The Company had no Level 2 assets or liabilities at December 31, 2018 or December 31, 2017; and
- Level 3—Unobservable inputs to the valuation methodology that are significant to the measurement of the fair value of assets or liabilities in which there is little or no market data. The Company had no Level 3 assets or liabilities at December 31, 2018 or December 31, 2017.

Accounts and Unbilled Receivables

Accounts receivable represent primarily commercial receivables associated with the Company's service fees, license fees, product sales and receivables from U.S. government contracts. Accounts receivable amounted to $1.5 million and $1.1 million as of December 31, 2018 and 2017, respectively. Unbilled receivables represent reimbursable costs in excess of billings and, where applicable, accrued profit related to long-term government contracts for which revenue has been recognized, but the customer has not yet been billed. Unbilled receivables amounted to $3.7 million and $0.2 million as of December 31, 2018 and 2017, respectively.

The Company evaluates the collectability of its receivables based on a variety of factors, including the length of time the receivables are past due, the financial health of its customers and historical experience. Based upon the review of these factors, the Company recorded no allowance for doubtful accounts at December 31, 2018 and 2017.

Property and Equipment

Property and equipment are stated at cost and depreciated using the straight-line method over the estimated useful lives of the assets ranging from five to ten years with the exception of leasehold improvements which are amortized over the shorter of the lease term or their estimated useful life.

Intangible Assets

Intangible assets include customer relationships, developed technology and trade names related to the Company's asset acquisition and have been capitalized and amortized over the estimated useful life of 15 years, 20 years and 15 years, respectively.

Impairment of Long-Lived Assets Other Than Goodwill

The Company assesses potential impairments to its long-lived assets whenever events or changes in circumstances indicate that the carrying value of an asset may not be recoverable. If indicators of impairment exist, the Company assesses the recoverability of the affected long-lived assets by determining whether the carrying value of such assets can be recovered through undiscounted future operating cash flow expected to result from the use of the assets. If the carrying amount is not recoverable, the Company measures the amount of any impairment by comparing the carrying value of the asset to the present value of the expected future cash flows associated with the use of the asset. No impairment was noted for the years ended December 31, 2018, 2017 or 2016.

Goodwill

Goodwill is the excess of purchase price over the aggregate fair values of tangible and intangible assets acquired, less liabilities assumed, in a business combination. The Company does not amortize goodwill. Instead, goodwill is tested for impairment annually and between annual tests if the Company becomes aware of an event or a change in circumstances that would indicate the carrying amount may be impaired. The Company performs its annual impairment testing as of December 31st of each year. The Company will first assess qualitative factors to determine whether the existence of events or circumstances suggests that it is more likely than not that goodwill is impaired. Unless it is more likely than not that goodwill is impaired, the Company does not perform the two-step impairment test. The Company's determination as to whether, and, if so, the extent to which, goodwill becomes impaired is highly judgmental and based on changes in the manner of its use of the acquired assets or its overall business strategy and regulatory, market and economic environment and trends. No impairment was noted as of December 31, 2018 or 2017.

Preclinical and Clinical Trial Accruals

The Company's clinical trial accruals are based on estimates of patient enrollment and related costs at clinical investigator sites, as well as estimates for the services received and efforts expended pursuant to contracts with multiple research institutions and clinical research organizations that conduct and manage clinical trials on the Company's behalf.

The Company estimates preclinical and clinical trial expenses based on the services performed, pursuant to contracts with research institutions and clinical research organizations that conduct and manage preclinical studies and clinical trials on its behalf. In accruing service fees, the Company estimates the time period over which services will be performed and the level of patient enrollment and activity expended in each period. If the actual timing of the performance of services or the level of effort varies from the estimate, the Company will adjust the accrual accordingly. Payments made to third parties under these arrangements in advance of the receipt of the related services are recorded as prepaid expenses until the services are rendered.

Revenue

The Company's revenue is related to the monetization of its protein production platform through collaboration agreements, service agreements, license agreements, government contracts and sales of reagent protein products, which may provide for various types of payments, including upfront payments, funding of research and development, milestone payments, intellectual property access fees and licensing fees. The Company's revenue generating agreements also include potential revenues for achieving milestones and for product royalties. The specifics of the Company's significant agreements are detailed in Note 7—Significant Research and Development Agreements.

The Company considers a variety of factors in determining the appropriate method of accounting for its collaboration agreements, including whether multiple deliverables can be separated and accounted for individually as separate units of accounting. Where there are multiple deliverables within a collaboration agreement that cannot be separated and therefore are combined into a single unit of accounting, revenues are deferred and recognized using the relevant guidance over the estimated period of performance. If the deliverables can be separated, the Company applies the relevant revenue recognition guidance to each individual deliverable. The specific methodology for the recognition of the underlying revenue is determined on a case-by-case basis according to the facts and circumstances applicable to each agreement. On a quarterly basis, the Company evaluates the period of performance to determine if a change should be made.

Upfront, nonrefundable licensing payments are assessed to determine whether or not the licensee is able to obtain standalone value from the license. Where the license does not have standalone value, non-refundable license fees are recorded as deferred revenue and recognized as revenue as the Company performs under the

applicable agreement. Where the level of effort is relatively consistent over the performance period, the Company recognizes fixed or determined revenue on a straight-line basis over the estimated period of performance. Where the license has standalone value, the Company recognizes total license revenue at the time all revenue recognition criteria have been met.

Nonrefundable payments for research funding are generally recognized as revenue over the period the underlying research activities are performed.

Revenue under service agreements are recorded as services are performed. These agreements do not require development achievement as a performance obligation and provide for payment when services are rendered. All such revenue is nonrefundable. Upfront, nonrefundable payments for license fees, exclusivity and feasibility services received in excess of amounts earned are classified as deferred revenue and recognized as income over the contract term or period of performance based on the nature of the related agreement.

The Company recognizes revenue for its cost-plus fixed fee government contracts in accordance with the authoritative guidance for revenue recognition including the authoritative guidance specific to federal government contractors. Reimbursable costs under the Company's government contracts primarily include direct labor, materials, subcontracts, accountable property and indirect costs. In addition, the Company receives a fixed fee under its government contracts, which is unconditionally earned as allowable costs are incurred and is not contingent on success factors. Reimbursable costs under the Company's government contracts, including the fixed fee, are generally recognized as revenue in the period the reimbursable costs are incurred.

The Company assesses milestone payments on an individual basis and recognizes revenue from nonrefundable milestone payments when the earnings process is complete and the payment is reasonably assured. Nonrefundable milestone payments related to arrangements under which the Company has continuing performance obligations are recognized as revenue upon achievement of the associated milestone, provided that (i) the milestone event is substantive and its achievability was not reasonably assured at the inception of the agreement, and (ii) the amount of the milestone payment is reasonable in relation to the effort expended or the risk associated with the milestone event. For the year ended December 31, 2018, $1.3 million in revenue was recognized in connection with the Merck and Jazz collaborations. For the years ended December 31, 2017 and 2016, $1.0 million and $0.8 million in revenue was recognized in connection with the achievement of development milestones associated with the Jazz collaboration, respectively.

The Company's reagent protein products are comprised of internally developed reagent protein products and those purchased from original manufacturers for resale. Revenues for reagent product sales are reflected net of attributable sales tax. The Company generally offers a 30-day return policy. The Company recognizes reagent product revenue from product sales when it is realized or realizable and earned. For the years ended December 31, 2018, 2017 and 2016, the Company has had minimal product returns related to reagent protein product sales. Therefore, no reserve for warranty and return rights was recorded as of December 31, 2018 or 2017.

Revenue under arrangements where the Company outsources the cost of fulfillment to third parties is evaluated as to whether the related amounts should be recorded gross or net. The Company records amounts collected from the customer as revenue, and the amounts paid to suppliers as cost of revenue when it holds all or substantially all of the risks and benefits related to the product or service. For transactions where the Company does not hold all or substantially all the risk, the Company uses net reporting and therefore records the transaction as if the end-user made a purchase from the supplier with the Company acting as a sales agent.

Cost of Revenue

Cost of revenue includes costs incurred in connection with the execution of service contracts. These are primarily reimbursable costs under the Company's government contracts and include costs for third-party

manufacturing, materials and internal labor. Costs related to government contract activities are generally recognized as incurred. Cost of revenue also includes costs to manufacture or purchase, package and ship the Company's reagent products; these costs are recognized upon shipment to the customer.

Research and Development Expenses

Research and development expenses are recognized as incurred and amounted to $33.9 million, $31.9 million and $32.4 million for the years ending December 31, 2018, 2017 and 2016, respectively.

Stock-Based Compensation

Employee stock-based compensation expense is measured at the grant date, based on the estimated fair value of the award, and is recognized as an expense, net of estimated forfeitures, over the requisite service period. Stock-based compensation expense is amortized on a straight-line basis over the requisite service period for the entire award, which is generally the vesting period of the award.

The Company estimates the fair value of stock options and other equity-based compensation using a Black-Scholes option pricing model on the date of grant. The Black-Scholes valuation model requires multiple subjective inputs, which are discussed further in Note 9 — Stock-Based Compensation. The fair value of equity instruments expected to vest are recognized and amortized on a straight-line basis over the requisite service period of the award, which is generally four years; however, certain provisions in the Company's equity compensation plan provides for shorter and longer vesting periods under certain circumstances.

Comprehensive Income (Loss)

Comprehensive income (loss) is defined as a change in equity of a business enterprise during a period, resulting from transactions from non-owner sources. There have been no items qualifying as other comprehensive income (loss) and, therefore, for all periods presented, the Company's comprehensive income (loss) was the same as its reported net income (loss).

Income Taxes

The Company utilizes 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. A deferred income tax asset or liability is computed for the expected future impact of differences between the financial reporting and income tax bases of assets and liabilities and for the expected future tax benefit, if any, to be derived from tax credits and loss carryforwards. Deferred income tax expense or benefit would represent the net change during the year in the deferred income tax asset or liability. Deferred tax assets, if any, are reduced by a valuation allowance when, in the opinion of management, it is more likely than not that some portion or all of the deferred tax assets will not be realized.

Net (Loss) Income per Share of Common Stock

Basic net (loss) income per common share is calculated by dividing the net (loss) income attributable to common stockholders by the weighted-average number of common shares outstanding during the period, without consideration for potentially dilutive securities. Diluted net (loss) income per share is computed by dividing net (loss) income by the weighted-average number of common shares outstanding and potentially dilutive securities during the period under the treasury stock method. For purposes of the diluted net (loss) income per share calculation, stock options and employee purchase plan shares are considered to be potentially dilutive securities. Securities are excluded from the computation of diluted net (loss) income per share if their effect would be anti-dilutive to earnings per share. Because the Company has reported a net loss for the years ended December 31, 2018 and 2017, diluted net loss per common share is the same as basic net loss per common share for those periods.

Recently Adopted Accounting Pronouncements

In November 2016, the Financial Accounting Standards Board (FASB) issued Accounting Standards Update (ASU) 2016-18, Statement of Cash Flows (Topic 230): Restricted Cash, which clarifies the presentation of restricted cash and restricted cash equivalents in the statements of cash flows. Under the ASU, restricted cash and restricted cash equivalents are included with cash and cash equivalents when reconciling the beginning-of-period and end-of-period total amounts presented on the statements of cash flows. The ASU is intended to reduce diversity in practice in the classification and presentation of changes in restricted cash on the Consolidated Statement of Cash Flows. The ASU requires that the Consolidated Statement of Cash Flows explain the change in total cash and equivalents and amounts generally described as restricted cash or restricted cash equivalents when reconciling the beginning-of-period and end-of-period total amounts. The ASU also requires a reconciliation between the total of cash and equivalents and restricted cash presented on the Consolidated Statement of Cash Flows and the cash and equivalents balance presented on the Consolidated Balance Sheet. The ASU was effective retrospectively on January 1, 2018, with early adoption permitted. This guidance was adopted during the quarter ended March 31, 2018. Upon adoption of this guidance, prior periods were retrospectively adjusted to conform to the current period's presentation. For the year ended December 31, 2017, the Company had previously disclosed $0.2 million of restricted cash as net cash used in financing activities. The effect of the adoption of ASU 2016-18 on the Company's consolidated statement of cash flows was to reduce net cash used in financing by $0.2 million and include restricted cash balances in the balances of cash and cash equivalents and restricted cash.

In May 2017, the FASB issued ASU 2017-09, Compensation—Stock Compensation (Topic 718), Scope of Modification Accounting. The new standard clarifies when to account for a change to the terms or conditions of a share-based payment award as a modification. ASU 2017-09 was effective for the Company in the first quarter of 2018, with early adoption permitted. The Company adopted this guidance during the quarter ended March 31, 2018, and the adoption did not have a material effect on its consolidated financial statements

Recently Issued Accounting Pronouncements

In May 2014, the FASB issued ASU No. 2014-09, *Revenue from Contracts with Customers (Topic 606)*, which supersedes the revenue recognition requirements in ASC 605, Revenue Recognition. This ASU is based on the principle that revenue is recognized to depict the transfer of goods or services to customers in an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services. The ASU also requires additional disclosure about the nature, amount, timing and uncertainty of revenue and cash flows arising from customer contracts, including significant judgments and changes in judgments and assets recognized from costs incurred to obtain or fulfill a contract. Numerous updates were issued in 2016 that provide clarification on a number of specific issues as well as requiring additional disclosures. The effective date is the Company's annual fiscal year 2019 and interim periods thereafter, using one of two retrospective application methods: the full retrospective method or the modified retrospective method. The Company plans to adopt the standard in fiscal year 2019 using the modified retrospective method. The Company does not expect the new standard to have a material impact on the recognition of revenue from its reagent protein product sales. The Company is currently evaluating the impact of the new standard on historical revenue recorded for its collaboration agreements. This ongoing evaluation is dependent upon the resolution of certain questions relating to the application of the new revenue recognition guidance for collaboration agreements which will ultimately determine the impact, if any, the adoption of this standard may have on the consolidated financial statements.

In February 2016, the FASB issued ASU No. 2016-02, *Leases (Topic 842)*, which was subsequently amended in July 2018 by ASU No. 2018-10, *Codification Improvements to Topic 842, Leases* and ASU No. 2018-11, *Leases (Topic 842): Targeted Improvements*. This ASU increases transparency and comparability by recognizing a lessee's rights and obligations resulting from leases by recording them on the balance sheet as right-of-use assets and lease liabilities. The new standard requires lessees to apply a dual approach, classifying leases as either finance or operating leases based on the principle of whether or not the lease is effectively a

financed purchase by the lessee. This classification dictates whether lease expense is to be recognized based on an effective interest method or on a straight-line basis over the term of the lease. Additional qualitative and quantitative disclosures will be required to give financial statement users information on the amount, timing and judgments related to a reporting entity's cash flows arising from leases. This guidance is effective for the Company in its annual fiscal year 2020 and interim periods thereafter. The Company is currently evaluating the impact of the adoption of this accounting standard update on its consolidated financial statements.

In January 2017, the FASB issued ASU No. 2017-04, *Intangibles—Goodwill and Other (Topic 350): Simplifying the Test for Goodwill Impairment*. This updated guidance eliminates Step 2 from the current two-step quantitative model for goodwill impairment tests. Step 2 required an entity to calculate an implied fair value, which included a hypothetical purchase price allocation requirement, for reporting units that failed Step 1. Per this updated guidance, a goodwill impairment will instead be measured as the amount by which a reporting unit's carrying value exceeds its fair value as identified in Step 1. This guidance is effective for fiscal years beginning after December 15, 2019, including interim periods within that reporting period. Early adoption is permitted for interim or annual goodwill impairment tests performed on testing dates after January 1, 2017. The adoption of this guidance is not expected to have a material impact on the consolidated financial statements.

In June 2018, the FASB issued ASU No. 2018-07, *Compensation-Stock Compensation (Topic 718),* which simplifies the accounting for nonemployee share-based payment transactions. The amendments specify that Topic 718 applies to all share-based payment transactions in which a grantor acquires goods or services to be used or consumed in a grantor's own operations by issuing share-based payment awards. The standard will be effective for the Company in the first quarter of fiscal year 2020, although early adoption is permitted (but no sooner than the adoption of Topic 606). The adoption of this guidance is not expected to have a material impact on the consolidated financial statements.

In August 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.* This new guidance aligns the requirements for capitalizing implementation costs incurred in a hosting arrangement that is a service contract with the requirements for capitalizing implementation costs incurred to develop or obtain internal-use software. ASU 2018-15 is effective for the Company beginning in the first quarter of fiscal year 2020, with early adoption permitted. The Company is currently evaluating this guidance to determine the impact on its financial statements and related disclosures.

In November 2018, the FASB issued ASU No. 2018-18, *Collaborative Arrangements (Topic 808)—Clarifying the Interaction between Topic 808 and Topic 606*. The amendments in ASU No. 2018-18 make targeted improvements to generally accepted accounting principles for collaborative arrangements by clarifying that certain transactions between collaborative arrangement participants should be accounted for as revenue under Accounting Standard Codification 606, *Revenue from Contracts with Customers*, or ASC 606, when the collaborative arrangement participant is a customer in the context of a unit of account. In those situations, all the guidance in ASC 606 should be applied, including recognition, measurement, presentation, and disclosure requirements. In addition, unit-of-account guidance in ASC 808 was aligned with the guidance in ASC 606 when an entity is assessing whether the collaborative arrangement or a part of the arrangement is within the scope of ASC 606. ASU No. 2018-18 is effective for fiscal years beginning after December 15, 2019, and interim periods within those fiscal years. Early adoption is permitted, including adoption in any interim period. The amendments in ASU No. 2018-18 are required to be applied retrospectively to the date of initial application of ASC 606. The Company is currently evaluating the impact of ASU No. 2018-08 on its consolidated financial statements.

2. Fair Value Measurements

The fair value measurements of the Company's cash equivalents and investments, which are measured at fair value on a recurring basis as of December 31, 2018 and 2017, were determined using the inputs described above and are as follows:

	Total	Fair Value Measurements at Reporting Data Using: Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
		(in thousands)		
December 31, 2018				
Cash and money market funds	$56,420	$56,420	$ —	$ —
Total assets measured at fair value	$56,420	$56,420	$ —	$ —
December 31, 2017				
Cash and money market funds	$57,864	$57,864	$ —	$ —
Total assets measured at fair value	$57,864	$57,864	$ —	$ —

Cash and money market funds at December 31, 2018 and 2017 include restricted cash, which is included in current assets on the balance sheet.

3. Cash, Cash Equivalents and Restricted Cash

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

	December 31, 2018	December 31, 2017
	(in thousands)	
Cash and cash equivalents	$56,220	$57,664
Restricted cash	200	200
Total cash, cash equivalents and restricted cash shown in statement of cash flows	$56,420	$57,864

4. Property and Equipment

Property and equipment consisted of the following:

	December 31,	
	2018	2017
	(in thousands)	
Furniture and equipment	$ 367	$ 355
Computers and IT equipment	451	368
Purchased software	375	931
Lab and research equipment	9,154	8,131
Leasehold improvements	876	865
Construction-in-progress	328	162
Other fixed assets	83	64
Total property and equipment, gross	11,634	10,876
Less: accumulated depreciation and amortization	(3,963)	(3,479)
Property and equipment, net	$ 7,671	$ 7,397

Total property and equipment assets under capital lease were $1.0 million and $1.1 million as of December 31, 2018 and 2017, respectively. Accumulated depreciation related to assets under capital lease as of these dates were $137 thousand and $94 thousand, respectively. For the years ended December 31, 2018, 2017 and 2016, total depreciation and amortization expense was $1.1 million, $0.9 million and $0.7 million, respectively, and is included in cost of revenue, research and development and selling, general and administrative expenses in the accompanying consolidated statements of operations as follows:

	Years ended December 31,		
	2018	2017	2016
	(in thousands)		
Cost of revenue	$ 51	$ —	$ —
Research and development	938	549	416
Selling, general and administrative	159	327	254
Total depreciation and amortization expense	$1,148	$ 876	$ 670

5. Intangible Assets

Intangible assets consisted of the following:

	December 31,	
	2018	2017
	(in thousands)	
Customer relationships	$ 3,750	$ 3,750
Developed technology	4,400	4,400
Trade names	920	910
Gross intangible assets	9,070	9,060
Less: Accumulated amortization	(4,822)	(4,289)
Total intangible assets, net	$ 4,248	$ 4,771

Amortization expense related to intangible assets was $0.5 million for each of the years ended December 31, 2018, 2017 and 2016, respectively. Amortization expense is included within selling, general and administrative expense in the accompanying consolidated statements of operations. As of December 31, 2018, estimated amortization expense for the next five years amounts to approximately $0.5 million per year.

6. Accrued Liabilities

Accrued liabilities consisted of the following:

	December 31,	
	2018	2017
	(in thousands)	
Accrued vacation	$ 493	$ 477
Deferred rent	589	620
Accrued bonuses	1,748	1,672
Other accrued employee-related liabilities	302	462
Accrued professional fees	1,524	575
Accrued supplier liability	387	690
Accrued subcontractor costs	4,265	2,681
Accrued clinical trial costs	—	866
Other accrued liabilities	504	870
Total accrued liabilities	$ 9,812	$ 8,913

Clinical trial for PF708 ended in the first half of 2018. No further clinical trial costs were required to be accrued. Activity related to preparing for PF708's NDA submission led to increased accruals for subcontractors and professional fees.

7. Significant Research and Development Agreements

The Company has two types of research and development agreements (i) those for which the Company co-develops or assists customers in developing their products (Collaboration Agreements), and (ii) those for which the Company receives funding to advance its own products (Funding Agreements).

Collaboration and License Agreements

Jazz

In July 2016, the Company entered into a development and license agreement with Jazz Pharmaceuticals for the development and commercialization of multiple early stage hematology/oncology product candidates, including PF743, a recombinant crisantaspase, and PF745, a recombinant crisantaspase with half-life extension technology, and in the third quarter of 2017, achieved a process development milestone. The agreement also includes an option for Jazz to negotiate a license for a recombinant pegaspargase product candidate with the Company. Under the agreement, the Company received an upfront and option payment totaling $15.0 million in July 2016 and may be eligible to receive additional payments based on achievement of certain research and development, regulatory and sales-related milestones.

In December 2017, the Company and Jazz entered into an amended and restated agreement. In connection with the amendment and restatement of the Jazz Agreement (as amended, the Amended Jazz Agreement), the Company received a total of $18.5 million, consisting of an upfront payment of $5.0 million and a payment of $13.5 million for development achievement. The Company may be eligible to receive additional payments under the Amended Jazz Agreement of up to $189.3 million based on achievement of certain research and development, regulatory and sales-related milestones. The total milestones are categorized as follows: $30.3 million based on achievement of certain research and development milestones; $34.0 million for certain regulatory milestones; and $125.0 million for sales milestones. For the non-sales-related milestones totaling $64.3 million, the Company conducted an evaluation as to whether they will be recorded using the milestone method and, as a result of this evaluation, estimates approximately $30.3 million of these non-sales-related milestones are deemed to be substantive. The Company may also be eligible to receive tiered royalties on

worldwide sales of any products resulting from the collaboration at rates reduced from those under the 2016 agreement. Both Jazz and the Company will be contributing to the development efforts. Unless terminated earlier, the Amended Jazz Agreement will continue on a product-by-product basis for as long as Jazz is commercializing or having commercialized the products under the Amended Jazz Agreement.

In accordance with ASC 605-25, the Company identified all of the deliverables at the inception of the Jazz Agreement and again upon entering into the Amended Jazz Agreement. The deliverables have not changed under the amendment. The significant deliverables were determined to be the research and development services related to the pegaspargase product candidate option and for license and research and development activities of the other hematology/oncology products. The Company has determined that the license, together with the research and development activities, represent one unit of accounting for each product under license, as the license does not have standalone value from the respective development activities. The research and development activities related to the pegaspargase option were determined to have standalone value apart from the license and development activities for the other hematology/oncology products. The estimated selling price for the pegaspargase product candidate and the hematology/oncology products was determined using an income approach. In determining the estimated selling price, the Company considered costs expected to be incurred for internal labor, burden rates, internal margins, and subcontractors. Based on the Company's considerations of estimated selling price, the Company allocated the original $15.0 million upfront and option payment as follows: $10.0 million to the pegaspargase product candidate and $2.5 million to each of the hematology/oncology products. For the $5.0 million upfront payment received under the terms of the Amended Jazz Agreement, the Company determined that $0.8 million represented development services performed prior to the amendment, which had been reimbursable under the original agreement. The remaining $4.2 million of the upfront payment was allocated to the remaining hematology product; the amount was deferred and will be recognized over the period of performance. The Amended Jazz Agreement provisions allow for Jazz to halt the advancement of one of the products under development and replace with others wherein the Company could potentially earn milestone revenue on those products. However, the Company believes it is unlikely Jazz would halt the advancement of the product under development and replace with other products. Therefore, none of the upfront payments were allocated to this option.

The upfront and option payment for the original Jazz agreement and the amendment are being deferred and will be recognized as revenue ratably over the period in which the Company expects services to be rendered for each respective unit of accounting. As previously disclosed, the estimated period of revenue recognition approximates a range of 15 to 32 months. Based on changes to this estimate that occurred during the quarter ended June 30, 2017, the Company modified the period of revenue recognition to range from 15 to 35 months. During the year ended December 31, 2017, the Company completed the service period related to one of the hematology products. In 2018, the Company achieved two development milestones and recognized $750 thousand in revenue for successful achievement of process development milestones for PF745. During the years ended December 31, 2018, 2017 and 2016, the Company recorded revenue of approximately $8.1 million, $21.6 million and $3.6 million related to the Jazz Collaboration, respectively. As of December 31, 2018 and 2017, deferred revenue associated with the Jazz collaboration was $2.7 million and $10.1 million, respectively. This deferred revenue will be recognized over the remaining period of performance from 3 to 6 months, subsequent to December 31, 2018.

NT Pharma

In April 2018, the Company entered into an agreement with NT Pharma under which the Company granted NT Pharma non-exclusive development and exclusive commercialization rights to PF708 in Mainland China, Hong Kong, Singapore, Malaysia and Thailand. In accordance with the agreement, the Company received an upfront payment of $2.5 million and may be eligible to receive up to $22.5 million in payments based on the achievement of certain development, regulatory, and sales-related milestones. In addition, the Company is eligible to receive double-digit royalties on net product sales. NT Pharma will be responsible for any further development required to achieve regulatory approval as well as commercialization activities in the applicable

territories. The Company deems that none of the non-sales milestones are substantive. Milestones that are not considered substantive would be recognized as revenue over the remaining period of performance, assuming all other revenue recognition criteria are met.

In accordance with ASC 605-25, the Company identified all of the deliverables at the inception of the NT Pharma Agreement. The significant deliverables were determined to be the license and research and development services up through the NDA filing related to the PF708 product. The Company has determined that these deliverables meet the separation criteria and therefore are each treated as separate units of accounting.

The upfront payment of $2.5 million was not fixed and determinable. Due to a contract clause, the $2.5 million could be payable to NT Pharma if the NDA was not filed by a specified date and additional deliverables were required after NDA submission. Therefore, the upfront payment was recorded as deferred revenue in the accompanying consolidated balance sheet at December 31, 2018. The NDA was filed in December 2018, and NT Pharma received the information contractually required in January 2019.

Alvogen

In June 2018, the Company entered into an agreement with Alvogen in which the Company has granted Alvogen exclusive rights to commercialize PF708 in the United States. The Company will continue to be responsible for development and registration of PF708, while Alvogen is providing additional regulatory and development expertise. Alvogen has assumed responsibility for costs related to litigation, commercial manufacturing and supply chain, and commercialization of PF708. In consideration for the licenses and other rights granted in the development and license agreement, the Company received an upfront payment of $2.5 million and may be eligible to receive an additional $25 million in support and regulatory milestone payments. The Company may also be eligible to receive a 50% gross profit split on sales if the product is rated as Therapeutically Equivalent (AP) to Forteo and up to 40% if rated differently. The Company deems that the support and regulatory milestones are substantive.

In February 2019, the Company and Alvogen entered into agreements expanding the Company's and Alvogen's collaboration to develop and commercialize PF708 to the EU, to certain countries in the Middle East and North Africa (MENA) and to the ROW territories (the latter defined as all countries outside of the EU, US and MENA, excluding Mainland China, Hong Kong, Singapore, Malaysia and Thailand). Pfenex will be eligible to receive additional upfront and milestone payments of $2.5 million for the EU and MENA and additional potential milestone payments for ROW. For the EU, MENA and ROW, Pfenex may also be eligible to receive a gross profit split of up to 60% on product sales, depending on geography and cost of goods sold. See footnote 14—Subsequent Events for further information.

In accordance with ASC 605-25, the Company identified all of the deliverables at the inception of the Alvogen Agreement. The significant deliverables were determined to be the development and regulatory services up through the NDA filing and ultimate approval related to the PF708 product and the exclusive license granted to Alvogen to commercialize PF708 in the United States. The Company has determined that the license and the development and regulatory activities meet the separation criteria; therefore, they are each treated as separate units of accounting.

To determine the stand-alone value of the license, the Company considered our negotiation discussions with Alvogen that led to the final terms of the agreement and other information. The Company determined a selling price for the services by estimating costs expected to be incurred for internal labor, burden rates, internal margins, and subcontractors.

The upfront payment of $2.5 million received in 2018 is not fixed and determinable due to a contract clause that $2.5 million may be payable to Alvogen if the NDA approval is not transferred to Alvogen by a specified date; therefore, the upfront payment has been recorded as deferred revenue in the accompanying consolidated

balance sheet. Alvogen supported certain agreed upon costs incurred by the Company in 2018 related to the preparation and filing of the NDA for PF708 totaling approximately $2.1 million. The Company recorded these reimbursement amounts in receivables and as a net against research and development expenses as of December 31, 2018 in the accompanying consolidated financial statements.

Pfizer

In February 2015, the Company entered into a development and license agreement with Pfizer (Pfizer Agreement) for the development and commercialization of PF582. Under the terms of the Pfizer Agreement, in March of 2015 the Company received a non-refundable license payment of $51.0 million on receipt of antitrust approval. Following Pfizer's strategic review of the current therapeutic focus of its biosimilar pipeline, the Company and Pfizer entered into a termination agreement in August 2016, pursuant to which the Pfizer Agreement was terminated and all rights to PF582 were returned to the Company. Upon termination, $45.8 million of previously deferred revenue was recognized. For the year ended December 31, 2016, the Company recognized $48.0 million as license revenue related to the Pfizer Agreement.

Funding Agreements

The U.S. Department of Health and Human Services

In July 2010, the Company entered into a contract with BARDA within the Office of the Assistant Secretary for Preparedness and Response in the U.S. Department of Health and Human Services to develop a production strain and process for the production of bulk recombinant protective antigen (rPA) from anthrax. The arrangement is a cost-plus fixed fee contract comprised of a base program and follow on options at BARDA's election. At the inception of the contract, both BARDA and the Company entered into the arrangement with the expectation that BARDA would fund all costs of development and no costs in excess of the arrangement would be incurred by the Company. In December 2014, the Company filed the investigational new drug (IND) application for Px563L. BARDA extended the contract in December 2014 and provided additional funding, increasing the total contract to $25.2 million. The development contract was completed in August 2015.

In August 2015, the Company entered into a contract with BARDA for the advanced development of Px563L and RPA563 as a novel vaccine candidate for the prevention of anthrax infection (BARDA Advanced Development Agreement). The BARDA Advanced Development Agreement is a cost-plus fixed fee development contract valued at up to approximately $143.5 million, including a 30-month base period of performance of approximately $15.9 million, and eight option periods valued at a total of approximately $127.6 million. The base period of performance was initially from August 2015 through February 2018 and later extended through September 2018. In addition to the base period, BARDA exercised additional phases of the development contract effective January 2017, totaling $4.9 million and allowing for the continuing development of Px563L and RPA563. The period of performance for the two option periods was extended through September 2018 and December 2019. Over the course of 2018, the Company continued to collect favorable stability data for both products and also completed feasibility studies that demonstrated the compatibility of both products with the USP compendial relative potency method for anthrax. In addition, the Company completed adjuvant manufacturing optimization and bulk drug substance manufacturing process establishment runs at the commercial contract manufacturer. Potential next milestones are the triggering of analytical and non-clinical animal study options, leading to potential Phase 2 study in 2019, subject in each case to continued funding by BARDA. In May 2018, BARDA increased the funding for one of the option periods by approximately $1.7 million. This modification increased the total contract value if all options are exercised by BARDA to approximately $145.2 million.

Revenue is recognized in accordance with the authoritative guidance for revenue recognition including the authoritative guidance specific to federal government contractors. Reimbursable costs under this government contract primarily include direct labor, materials, subcontracts, accountable property and indirect costs. In

addition, the Company receives a fixed fee under the BARDA contract, which is unconditionally earned as allowable costs are incurred and is not contingent on success factors. Reimbursable costs under this BARDA contract, including the fixed fee, are generally recognized as revenue in the period the reimbursable costs are incurred. The Company recorded revenues of $4.8 million, $5.5 million and $5.0 million for services performed in the years ended December 31, 2018, 2017 and 2016, respectively. Reimbursable costs related to fulfilling on this contract amounted to $3.7 million, $3.5 million and $3.9 million for the years ended December 31, 2018, 2017 and 2016, respectively, and are reflected in cost of revenue in the accompanying consolidated statements of operations. The billing of any overage in indirect cost rates over the approved provisional rates in the contract is not allowed. Any such overage is expensed as incurred. When and if final rates with Defense Contract Audit Agency are approved, the Company will recognize any change in revenue resulting from the rate change in the period such revised rates are approved and as such this would be considered a change in estimate. This agreement is subject to early termination and stop-work order in conformance with Federal Acquisition Regulations 52.249-6 and 52.242-15 whereupon BARDA may immediately terminate the agreement early for convenience or request the Company to stop all or any part of the work for a period of at least 90 days. If BARDA is not adequately funded, there is a potential that some or all of the follow-on options could be delayed or never elected.

The National Institute of Allergy and Infectious Diseases

In September 2012, the Company entered into a contract with the National Institute of Allergy and Infectious Diseases (NIAID) to provide services to advance vaccine components and technologies that accelerate the immune response for use in post-event settings following the intentional release of the NIAID Category A Priority Pathogen Bacillus anthracis or in response to naturally occurring outbreaks of infectious diseases caused by NIAID Category A Priority Pathogen B. anthracis. The arrangement was a cost-plus fixed fee contract comprised of a base program and 13 follow-on options at NIAID's election. At the inception of the contract, both NIAID and the Company entered into the arrangement with the expectation that NIAID would fund all costs of development and no costs in excess of the arrangement would be incurred by the Company. The total amount of the contract including options was $22.9 million, with $2.2 million eligible for payment during the base program of approximately 14 months. The fixed fee was paid as specific activities were completed. NIAID exercised the first option period effective in January 2015, increasing the funding to $3.0 million. NIAID exercised the second option period effective May 2016, increasing the funding to approximately $4.1 million. The contract was extended through the end of December 31, 2017, when the development contract was completed in accordance with its terms.

Revenue was recognized in accordance with the authoritative guidance for revenue recognition including the authoritative guidance specific to federal government contractors. Reimbursable costs under this government contract primarily included direct labor, subcontracts and indirect costs. In addition, the Company received a fixed fee under the NIAID contract, which was unconditionally earned as allowable costs were incurred and was not contingent on success factors. Reimbursable costs under this NIAID contract, including the fixed fee, were generally recognized as revenue in the period the reimbursable costs were incurred. The Company recorded revenues of $0.3 million and $0.5 million for services performed in the years ended December 31, 2017 and 2016, respectively. Reimbursable costs related to fulfilling this contract amounted to $0.3 million and $0.4 million for the years ended December 31, 2017 and 2016, respectively, and are reflected in cost of revenues in the accompanying consolidated statements of operations. The billing of any overage in indirect cost rates over the approved provisional rates in the contract is not allowed. Such overage was expensed as incurred. When and if final rates with Defense Contract Audit Agency are approved, the Company will recognize any change in revenue resulting from the rate change in the period such revised rates are approved and as such this would be considered a change in estimate.

8. Commitments and Contingencies

Lease Agreements

In June 2010, the Company entered into an operating lease agreement (Lease) with a landlord for an initial term of 10 years, for its corporate headquarters comprised of one building located in San Diego, California. Occupation of the premises under the Lease began in April 2011. Under the terms of the Lease, the Company pays annual base rent, subject to an annual fixed percentage increase, plus its share of common operating expenses and tax obligations. The annual base rent was subject to abatement of 50% for the first year of the Lease. The Company recognizes rent expense on a straight-line basis over the lease term.

In September 2014, the Company amended the Lease to extend the term for an additional three years through March 31, 2024 and to an additional 7,315 square feet of leased space. The extended term on the existing space increased total estimated rent payments by approximately $1.4 million. Base rent payments for the new space commenced in December 2014 and increased total estimated rent payments over the life of the Lease by approximately $1.5 million. In November 2015, the Company further amended the Lease to add facilities consisting of 16,811 square feet. Base rent payments for the new space commenced in March 2016 and June 2016 and increased total estimated rent payments over the life of the Lease by approximately $2.3 million. In 2017, a sublease agreement was executed with a tenant to lease a portion of leased space from the Company for a term under one year. The amounts received are offset against rent expense.

Rent expense was $0.8 million, $0.7 million, and $0.7 million for the years ended December 31, 2018, 2017 and 2016, respectively, which is included in cost of revenue, research and development and selling, general and administrative expenses in the accompanying consolidated statements of operations as follows:

	Years Ended December 31,		
	2018	2017	2016
	(in thousands)		
Cost of revenue	$ 42	$ —	$ —
Research and development	417	326	364
Selling, general and administrative	293	407	375
Total rent expense	$752	$ 733	$ 739

In addition to the Lease, the Company has entered into operating and capital lease agreements for office and lab equipment that expire at various dates through 2021.

As of December 31, 2018, the total estimated future annual minimum lease payment obligations under the Company's non-cancelable leasing arrangements, including the facilities lease described above, are as follows:

	Payment Amounts		
	Operating Leases	Capital Leases	Total
	(in thousands)		
2019	$ 901	$344	$1,245
2020	899	197	1,096
2021	909	1	910
2022	934	—	934
2023 and thereafter	1,206	—	1,206
Total future minimum lease payments	$4,849	$542	$5,391

Clinical Study and Development Activity Commitments

The Company has entered into agreements with contract research organizations and subcontractors to further develop its product candidates. The total contracted costs under these arrangements totaled approximately

$30.9 million as of December 31, 2018, of which $24.5 million has been incurred to date. These contracts can be cancelled at any time, with some having certain cancellation fees associated with the termination of the contract, and others that only obligate the Company through the termination date.

Contingencies

From time to time, the Company may be involved in legal proceedings, claims, and litigation in the ordinary course of business. At December 31, 2018 and 2017, there were no material legal proceedings.

9. Stock-Based Compensation

Summary Stock-Based Compensation Information

The following table summarizes stock-based compensation expense:

	Years Ended December 31,		
	2018	2017	2016
		(in thousands)	
Cost of revenues	$ 157	$ 265	$ 225
Research and development	1,418	1,028	822
Selling, general and administrative	1,604	1,830	2,109
Total	$3,179	$3,123	$3,156

	2018	2017	2016
		(in thousands)	
Stock-based compensation from:			
Stock options	$ 3,008	$ 2,993	$ 2,983
Employee stock purchase plan	171	130	173
Total	$ 3,179	$ 3,123	$ 3,156

Stock Option Plan

The Company's board of directors adopted, and the Company's stockholders approved, the Company's 2009 Equity Incentive Plan (2009 Plan) in 2009. The 2009 Plan terminated in connection with the Company's IPO in 2014 and, accordingly, no awards will be granted under the 2009 Plan following the IPO. However, the 2009 Plan will continue to govern outstanding awards granted thereunder. An aggregate of 1.1 million shares of common stock was reserved for issuance under the 2009 Plan. The 2009 Plan provided for the grant of incentive stock options and for the grant of nonstatutory stock options, restricted stock, restricted stock units, and stock appreciation rights to the Company's employees, directors and consultants. As of December 31, 2018, awards covering 0.4 million shares of common stock were outstanding under the 2009 Plan.

In July 2014, the board of directors adopted a 2014 Equity Incentive Plan (2014 Plan) and the Company's stockholders approved it. In May 2017, the Company's stockholders approved an amendment to the 2014 Equity Incentive Plan (2014 Amended Plan), to, among other things, increase the available shares by 2.5 million. The 2014 Amended Plan provides for the grant of incentive stock options, within the meaning of Section 422 of the Internal Revenue Code, to employees and any parent and subsidiary corporations' employees, and for the grant of nonstatutory stock options, restricted stock, restricted stock units, stock appreciation rights, performance units and performance shares to employees, directors and consultants and parent and subsidiary corporations' employees and consultants. The shares available for issuance under the 2014 Amended Plan include shares returned to the 2009 Plan as the result of expiration or termination of awards (provided that the maximum number of shares that may be added to the 2014 Amended Plan pursuant to such previously granted awards under

the 2009 Plan is 961,755 shares). The maximum number of shares that may be issued under the 2014 Amended Plan is 5.5 million plus shares added from 2009 Plan, if any. As of December 31, 2018, a total of 2.1 million shares of common stock were available for issuance pursuant to the 2014 Amended Plan. As of December 31, 2018, awards covering 3.4 million shares of common stock were outstanding under the 2014 Amended Plan.

In September 2016, the board of directors adopted the 2016 Inducement Equity Incentive Plan (2016 Plan). The 2016 Plan provides for the grant of nonstatutory stock options, restricted stock, restricted stock units, stock appreciation rights, performance units and performance shares to new employees. Stock options granted under the 2016 Plan have a term of ten years from the date of grant, the exercise price for the shares to be issued will be no less than 100% of the fair market value per share on the date of grant and generally vest over a four-year period. The maximum aggregate number of shares that may be issued under the 2016 Plan is 500,000 shares. As of December 31, 2018, a total of 0.1 million shares of common stock were available for issuance pursuant to the 2016 Plan. As of December 31, 2018, awards covering 0.4 million shares of common stock were outstanding under the 2016 Plan.

Stock options granted to date under the 2009 Plan and the 2014 Plan have a term of ten years from the date of grant, and generally vest over a four-year period. However, in the event that an incentive stock option (ISO) granted to a participant who, at the time the ISO is granted, owns stock representing more than ten percent (10%) of the total combined voting power of all classes of stock of the Company, the term of the ISO shall be five years from the grant date or such shorter term as may be provided in the award agreement.

In July 2014, the board of directors adopted the 2014 Employee Stock Purchase Plan (ESPP) and the stockholders approved it. As of December 31, 2018, a total of 1,584,800 shares of common stock were available for issuance under the ESPP. In addition, the ESPP provides for annual increases in the number of shares available for sale under the ESPP on the first day of each fiscal year beginning in 2015, equal to the least of: (i) 355,618 shares; (ii) 1.5% of the outstanding shares of the common stock on the last day of the immediately preceding fiscal year; or (iii) such other amount as may be determined by the administrator. As of December 31, 2018, 131,305 shares have been purchased under the ESPP.

Stock Options

The exercise price of all options granted during the years ended December 31, 2018, 2017 and 2016 was equal to the estimated fair value of the underlying common stock on the date of grant. The fair value of each stock option granted is estimated on the grant date under the fair value method using the Black-Scholes model. The estimated fair values of the stock option, including the effect of estimated forfeitures, are then expensed over the requisite service period which is generally the vesting period. The following assumptions were used to estimate the fair value of stock options:

	Years Ended December 31,		
	2018	2017	2016
Risk-free interest rate	2.7%	1.9%	1.5%
Expected volatility	71.2%	66.3%	67.5%
Expected dividend yield	0.0%	0.0%	0.0%
Expected life of options in years	6.3	5.5	6.2

The fair value of equity instruments that are ultimately expected to vest, net of estimated forfeitures, are recognized and amortized on a straight-line basis over the requisite service period. The Black-Scholes option-pricing model requires multiple subjective inputs, including a measure of expected future volatility. Prior to the Company's IPO in 2014, the Company's stock did not have a readily available market. Consequently, the expected future volatility was based on the historical volatility for comparable publicly traded companies over the most recent period commensurate with the estimated expected term of the Company's stock options.

Beginning in the fourth quarter of 2016, the expected future volatility was based on the historical volatility for the Company's common stock. Following the completion of the Company's IPO, the fair value of options granted is based on the closing price of the Company's common stock on the date of grant as quoted on the NYSE American.

The risk-free interest rate assumption is based upon observed interest rates during the period appropriate for the expected term of the options. The expected term of the options has been estimated using the simplified method to determine the expected life of the Company's options due to insufficient activity as a basis from which to estimate future exercise patterns. With the exception of 1,217,784 shares of common stock issued in connection with the payment of all accrued and unpaid dividends on the preferred stock immediately prior to the completion of the Company's IPO, the Company had never declared or paid dividends and has no plans to do so in the foreseeable future. Accordingly, the dividend yield assumption is based on the expectation that the Company will not pay dividends on its common stock in the future. Authoritative guidance requires forfeitures to be estimated at the time of grant and revised, if necessary, in subsequent periods if actual forfeitures differ from those estimates. The weighted-average grant date fair values of options granted during the years ended December 31, 2018, 2017 and 2016 were $2.47, $2.92 and $5.47, respectively. Total fair value of shares vested during the years ended December 31, 2018, 2017 and 2016 was $2.7 million, $3.9 million and $972 thousand, respectively.

Stock option transactions under the 2009, 2014 and 2016 Plans during the year ended December 31, 2018 were as follows:

	Number of Options (in thousands)	Weighted Average Exercise Price	Weighted Average Remaining Contractual Term (in years)	Aggregate Intrinsic Value (in thousands)
Outstanding at January 1, 2018	3,237	$7.50		
Granted	1,789	3.77		
Exercised	(44)	2.13		
Cancelled (forfeited)	(827)	6.62		
Outstanding at December 31, 2018	4,155	$6.13	7.30	$432
Vested and expected to vest at December 31, 2018	3,640	$6.39	7.05	$431
Vested and exercisable at December 31, 2018	1,981	$7.92	5.52	$429

The Company received $94 thousand, $26 thousand and $123 thousand for the years ended December 31, 2018, 2017 and 2016, respectively, for options exercised.

As of December 31, 2018, there was approximately $3.8 million of unrecognized compensation cost related to unvested stock option awards, and the weighted-average period over which this cost is expected to be recognized is 2.57 years.

The total aggregate intrinsic value, which is the amount, if any, by which the exercise price was exceeded by the estimated fair value of the Company's common stock, of options exercised, was $0.1 million, $0.3 million and $0.6 million for the years ended December 31, 2018, 2017 and 2016, respectively.

10. Retirement Plan

The Company has a 401(k) Savings Plan (401(k)). The 401(k) is for the benefit of all qualifying employees and permits voluntary contributions by employees up to a maximum percentage allowable by current IRS regulations. During the years ended December 31, 2018, 2017 and 2016, the Company made matching contributions to the 401(k) of $0.3 million, $0.2 million and $0.2 million, respectively.

11. Income Taxes

The components of the income tax (benefit) expense are as follows:

	Years Ended December 31,		
	2018	2017	2016
		(in thousands)	
Current	$ —	$(172)	$(2,164)
Deferred	—	—	1,955
Total benefit	$ —	$(172)	$ (209)

For the year ended December 31, 2018, the Company recorded zero tax expense. For the years ended December 31, 2017 and 2016, the Company recorded an income tax provision benefit of $0.2 million attributable to U.S. Federal refundable alternative minimum tax and state income tax. The Company's practice is to recognize interest and/or penalties related to income tax matters in income tax expense. The Company had no accrual for interest or penalties on its balance sheets at December 31, 2018 and 2017. The Company is subject to taxation in the United State and various state jurisdictions. The Company's tax years 2013 and forward are subject to examination by the United States and tax years 2009 and forward in California and various state tax authorities.

On December 22, 2017, the U.S. government enacted comprehensive tax legislation commonly referred to as the Tax Cuts and Jobs Act (the "Tax Act"). The Tax Act makes broad and complex changes to the U.S. tax code, including, but not limited to, reducing the U.S. federal corporate tax rate from 35 percent to 21 percent for tax years beginning after December 31, 2017.

Pursuant to the SEC Staff Accounting Bulletin ("SAB") No. 118, "Income Tax Accounting Implications of the Tax Cuts and Jobs Act" ("SAB 118"), a company may select between one of three scenarios to determine a reasonable estimate arising from the Tax Act. Those scenarios are (i) a final estimate which effectively closes the measurement window; (ii) a reasonable estimate leaving the measurement window open for future revisions; and (iii) no estimate as the law is still being analyzed. The Company was able to provide a reasonable estimate for the revaluation of deferred taxes by recording a net tax provision of $6.4 million in the period ending December 31, 2017 which is offset by a full valuation allowance. This tax expense is primarily due to the corporate rate reduction. The Company has also recorded a tax benefit of $0.2 million for the AMT credits which are refundable in tax year 2018 through 2022. During the quarter ended December 31, 2018, the Company completed its accounting for the impacts of the Tax Act. There were no significant changes to its estimate.

As of December 31, 2018, the Company had federal and state research and development credits carryforwards of approximately $6.6 million and $3.5 million, respectively, to offset potential tax liabilities. The federal research and development credits have a 20-year carryforward period and begin to expire in 2030 unless utilized. California research and development tax credits have no expiration. The Company has $79.9 million federal net operating loss carryforwards and $44.4 million of state net operating loss carryforwards as of December 31, 2018. Of the total federal net operating loss carryforwards, we have $38.4 million with no expiration dates. The remaining federal and state net operating losses can be carried forward until 2037 unless utilized.

Pursuant to Internal Revenue Code (IRC) Sections 382 and 383, annual use of the Company's net operating loss and research and development credit carryforwards may be limited in the event a cumulative change in ownership of more than 50% occurs within a three-year period. The Company completed an IRC Section 382/383 analysis through December 31, 2014 regarding the limitation of net operating loss and research and development credit carryforwards and found that a greater than 50% cumulative change in ownership occurred in August 2014 in conjunction with the Company's initial public offering. The Company has significant built in gains; therefore all the pre-change net operating losses were available for utilization.

The Company has not analyzed whether it has experienced an ownership change for purposes of Sections 382 and 383 of the Code since 2014. It may have experienced an ownership change in connection with the sale of securities pursuant to a predecessor registration statement or otherwise and it may experience ownership changes in the future as a result of shifts in its stock ownership. The Company plans to complete a Section 382/383 analysis as of December 31, 2018 to determine if it had an ownership change. As a result, if or when it earns net taxable income, the Company's ability to use its pre-change NOLs to offset such taxable income may be subject to limitations.

Significant components of the Company's deferred tax assets as of December 31, 2018 and 2017 are shown below. A valuation allowance of $30.5 million and $19.2 million for the years ended December 31, 2018 and 2017, respectively, has been established to offset deferred tax assets as realization of such assets is uncertain.

	December 31,	
	2018	2017
	(in thousands)	
Deferred tax assets		
Net operating losses	$ 19,860	$ 10,968
Stock-based compensation	1,502	1,196
Research and development credits	8,157	5,473
Deferred revenue	1,907	2,581
Accruals and other	678	696
Total deferred tax assets	32,104	20,914
Deferred tax liabilities		
Depreciation and amortization	(464)	(436)
Intangible assets	(1,097)	(1,267)
Total deferred tax liabilities	(1,561)	(1,703)
Valuation allowance	(30,543)	(19,211)
Net deferred tax asset	$ —	$ —

The provision for income taxes differs from the U.S. federal statutory tax rate primarily due to state and local income taxes, valuation allowance established, R&D credits and the impact of tax reform. A reconciliation of the Company's effective tax rate and federal statutory tax rate at December 31, 2018, 2017 and 2016 is as follows:

	December 31,		
	2018	2017	2016
		(in thousands)	
Federal income taxes	$ (8,328)	$ (8,791)	$ 1,792
State income taxes	(1,065)	(949)	190
State rate changes	110	(392)	(1,080)
Impact of change in federal income tax rates	—	6,401	—
Stock-based compensation	401	623	489
Valuation allowance	11,332	4,728	130
Research and development credits	(2,684)	(1,897)	(1,683)
Permanent items and other	234	105	(47)
Total income tax (benefit) expense	$ —	$ (172)	$ (209)

In accordance with authoritative guidance, the impact of an uncertain income tax position on the income tax return must be recognized at the largest amount that is more-likely-than-not to be sustained upon audit by the

relevant taxing authority. An uncertain income tax position will not be recognized if it has less than a 50% likelihood of being sustained. The Company has an uncertain tax position with respect to its research and development credits as of December 31, 2018.

The following is a tabular reconciliation of the Company's Unrecognized Tax Benefits activity (excluding interest and penalties):

	December 31,		
	2018	2017	2016
	(in thousands)		
Beginning balance of unrecognized tax benefits	$1,032	$ 730	$ 301
Additions based on tax positions related to the current year	351	361	369
Additions based on tax positions of prior years	11	—	79
Reductions for tax positions of prior years	—	(59)	(19)
Ending balance of unrecognized tax benefits	$1,394	$1,032	$ 730

As of December 31, 2018, if recognized, approximately $1.4 million would affect the effective tax rate if the Company did not have a full valuation allowance.

The Company's practice is to recognize interest and/or penalties related to income tax matters in income tax expense. No accrued interest or penalties were included in its consolidated balance sheets at December 31, 2018 or 2017, and the Company did not recognize any interest and/or penalties in its consolidated statements of operations during the years ended December 31, 2018, 2017, or 2016.

The Company does not anticipate significant increases or decreases within the next 12 months with respect to its unrecognized tax benefit.

The Company is subject to income tax in the United States, California and Massachusetts. The Company is subject to income tax examination by various state tax authorities for the years beginning in 2009 due to net operating losses and state statutes.

12. Net (Loss) Income Per Share of Common Stock

The following table summarizes the computation of basic and diluted net (loss) income per share attributable to common stockholders of the Company:

	December 31,		
	2018	2017	2016
	(in thousands, except per share data)		
Net (loss) income	$(39,593)	$(25,684)	$ 5,481
Weighted average shares used to compute basic net (loss) income per share	28,340	23,503	23,389
Dilutive effect of employee stock option plans	—	—	299
Dilutive weighted-average common shares outstanding	28,340	23,503	23,688
Basic and diluted net (loss) income per common share	$ (1.40)	$ (1.09)	$ 0.23

Basic net (loss) income per share is computed by dividing the net (loss) income by the weighted-average number of common shares outstanding for the period. Diluted net (loss) income per share is computed by dividing the net (loss) income by the weighted-average number of common shares and dilutive common stock equivalents outstanding for the period, determined using the treasury-stock method, if inclusion of these is dilutive. Because the Company reported a net loss for the years ended December 31, 2018 and 2017, diluted net loss per common share is the same as basic net loss per common share for those periods.

The following potentially dilutive securities outstanding at the end of the periods presented have been excluded from the computation of diluted shares outstanding because of their anti-dilutive impact to earnings per share:

	December 31,		
	2018	2017	2016
	(in thousands)		
Options to purchase common stock	4,155	3,237	1,774
Employee stock purchase plan	61	75	60
Total	4,216	3,312	1,834

13. Quarterly Financial Data (unaudited)

The following is a summary of the quarterly results of the Company for the years ended December 31, 2018 and 2017:

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year Ended December 31
	(in thousands, except for per share data)				
2018					
Revenues	$ 3,746	$ 4,190	$ 3,570	$ 3,351	$ 14,857
Cost of revenues	1,520	924	1,479	1,099	5,022
Gross profit	2,226	3,266	2,091	2,252	9,835
Operating expenses	13,256	14,386	12,868	9,176	49,686
Other income, net	3	39	115	101	258
Net loss	(11,027)	(11,081)	(10,662)	(6,823)	(39,593)
Net loss per common share, basic and diluted	$ (0.47)	$ (0.41)	$ (0.34)	$ (0.22)	$ (1.40)
Weighted-average common shares used in calculating basic and diluted net loss per share	23,569	26,771	31,437	31,461	28,340
2017					
Revenues	$ 2,818	$ 3,029	$ 5,024	$17,909	$ 28,780
Cost of revenues	810	905	1,766	1,675	5,156
Gross profit	2,008	2,124	3,258	16,234	23,624
Operating expenses	12,084	14,486	12,111	10,918	49,599
Other income, net	44	38	35	2	119
Income tax benefit	—	—	—	172	172
Net (loss) income	(10,032)	(12,324)	(8,818)	5,490	(25,684)
Net (loss) income per share, basic and diluted	$ (0.43)	$ (0.52)	$ (0.37)	$ 0.23	$ (1.09)
Weighted-average common shares used in calculating net (loss) income per share:					
Basic	23,436	23,486	23,539	23,548	23,503
Diluted	23,436	23,486	23,539	23,697	23,503

14. Subsequent Events

In February 2019, the Company and Alvogen entered into agreements expanding their collaboration to develop and commercialize PF708 to the EU, to certain countries in the Middle East and North Africa (MENA) and to the ROW territories (the latter defined as all countries outside of the EU, US and MENA, excluding Mainland China, Hong Kong, Singapore, Malaysia and Thailand). The Company believes this collaboration

leverages Alvogen's international experience and expertise in regulatory, IP and supply chain activities, as well as its network of specialty marketing and sales pharmaceutical companies in these regions. Subject to applicable regulatory approvals, PF708 will be commercialized in Europe and Switzerland by Theramex, a leading global specialty pharmaceutical company dedicated to Women's Health, in MENA by SAJA, a Tamer Group company, and in ROW by Alvogen's current and/or future commercialization partners. Under the terms of the agreements, Alvogen will be responsible for the local activities through Theramex, SAJA and its other commercialization partners and for overseeing any clinical development, regulatory, litigation, commercial manufacturing and commercialization. Pfenex is eligible to receive additional upfront and milestone payments of $2.5 million for the EU and MENA and additional potential milestone payments for ROW. For EU, MENA and ROW, Pfenex may also be eligible to receive a gross profit split of up to 60% on product sales, depending on geography and cost of goods sold.

Item 9. ***Changes in and Disagreements with Accountants on Accounting and Financial Disclosure***

None.

Item 9A. ***Controls and Procedures***

Evaluation of Disclosure Controls and Procedures

Our management, with the participation of our Principal Executive Officer and Principal Financial Officer, has evaluated the effectiveness of our disclosure controls and procedures as of the end of the period covered by this Annual Report on Form 10-K. The term "disclosure controls and procedures," as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934, as amended (Exchange Act), means controls and other procedures of a company that are designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the Securities and Exchange Commission's (SEC) rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is accumulated and communicated to management, including its principal executive and principal financial officers, or persons performing similar functions, as appropriate to allow timely decisions regarding required disclosure. Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Based upon that evaluation, our Principal Executive Officer and Principal Financial Officer concluded that our disclosure controls and procedures were effective at the reasonable assurance level as of December 31, 2018 to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements in accordance with GAAP.

Management's Annual Report on Internal Control Over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting (as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act). Management conducted an assessment of the effectiveness of our internal control over financial reporting based on the criteria set forth in Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework). Based on this assessment, management has concluded that its internal control over financial reporting was effective as of December 31, 2018.

Our independent registered public accounting firm, KPMG LLP, is not required to and has not issued an attestation report as of December 31, 2018 due to a transition period established by the rules of the SEC for newly public companies that have not lost their "emerging growth company" status as defined in the JOBS Act.

Changes in Internal Control Over Financial Reporting

There were no changes in our internal control over financial reporting identified in connection with the evaluation required by Rule 13a-15(d) and 15d-15(d) of the Exchange Act that occurred during the quarter ended December 31, 2018 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

Inherent Limitations on Effectiveness of Controls

Management recognizes that a control system, no matter how well designed and operated, can provide only reasonable, not absolute, assurance that the objectives of the control system are met. Further, the design of a control system must reflect the fact that there are resource constraints and that management is required to apply its judgment in evaluating the benefits of possible controls and procedures relative to their costs. Because of the

inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud or error, if any, have been detected. These inherent limitations include the realities that judgments in decision making can be faulty, and that breakdowns can occur because of a simple error or mistake. Additionally, controls can be circumvented by the individual acts of some persons, by collusion of two or more people, or by management override of the controls. The design of any system of controls also is based in part upon certain assumptions about the likelihood of future events, and there can be no assurance that any design will succeed in achieving its stated goals under all potential future conditions; over time, controls may become inadequate because of changes in conditions, or the degree of compliance with policies or procedures may deteriorate. Because of the inherent limitations in a cost-effective control system, misstatements due to error or fraud may occur and not be detected.

Item 9B. ***Other Information***

Not applicable.

PART III

Item 10. *Directors, Executive Officers and Corporate Governance*

The information required by this item is incorporated herein by reference from our definitive proxy statement relating to our 2019 annual meeting of shareholders. The definitive proxy statement will be filed with the Securities and Exchange Commission within 120 days after the end of the 2018 fiscal year.

Codes of Ethics and Conduct

Our board of directors has adopted a code of business conduct and ethics that applies to all of our employees, officers, and directors, including our Chief Executive Officer, Chief Financial Officer, and other executive and senior financial officers. The full text of our Code of Ethics and Conduct is posted on the investor relations page of our website at http://pfenex.investorroom.com/corporate-governance. We will post amendments to our Code of Ethics and Conduct or waivers of our Code of Ethics and Conduct for directors and executive officers on the same website.

Item 11. *Executive Compensation*

The information required by this item is incorporated herein by reference from our definitive proxy statement relating to our 2019 annual meeting of shareholders. The definitive proxy statement will be filed with the Securities and Exchange Commission within 120 days after the end of the 2018 fiscal year.

Item 12. *Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters*

The information required by this item is incorporated herein by reference from our definitive proxy statement relating to our 2019 annual meeting of shareholders. The definitive proxy statement will be filed with the Securities and Exchange Commission within 120 days after the end of the 2018 fiscal year.

Item 13. *Certain Relationships and Related Transactions and Director Independence*

The information required by this item is incorporated herein by reference from our definitive proxy statement relating to our 2019 annual meeting of shareholders. The definitive proxy statement will be filed with the Securities and Exchange Commission within 120 days after the end of the 2018 fiscal year.

Item 14. *Principal Accounting Fees and Services*

The information required by this item is incorporated herein by reference from our definitive proxy statement relating to our 2019 annual meeting of shareholders. The definitive proxy statement will be filed with the Securities and Exchange Commission within 120 days after the end of the 2018 fiscal year.

PART IV

Item 15. ***Exhibits and Financial Statement Schedules***

(a) The following documents are filed as part of this report:

1. Financial Statements

   See Index to Financial Statements at Item 8 herein.

2. Financial Statement Schedules

SCHEDULE II—VALUATION AND QUALIFYING ACCOUNTS

	Years Ended December 31,		
	2018	2017	2016
		(in thousands)	
Allowance for Doubtful Accounts:			
Beginning balance	$ —	$ 50	$ 408
Reductions and write-offs	—	(50)	(358)
Ending balance	$ —	$ —	$ 50

All other schedules have been omitted because they are not required, not applicable, or the required information is otherwise included.

3. Exhibits

The documents listed in the Exhibit Index of this Annual Report on Form 10-K are incorporated by reference or are filed with this report, in each case as indicated therein (numbered in accordance with Item 601 of Regulation S-K).

EXHIBIT INDEX

Exhibit Number	Description	Incorporated by Reference			
		Form	File No.	Exhibit	Filing Date
3.1	Amended and Restated Certificate of Incorporation of the Registrant.	8-K	001-36540	3.2	July 29, 2014
3.2	Amended and Restated Bylaws of the Registrant.	S-1	333-196539	3.3	June 5, 2014
4.1	Specimen Stock Certificate.	S-1/A	333-196539	4.1	June 23, 2014
10.1+	2009 Equity Incentive Plan and form of award thereunder.	S-1	333-196539	10.1	June 5, 2014
10.2+	Amended and Restated 2014 Equity Incentive Plan and form of award thereunder.	8-K	001-36540	10.1	May 8, 2017
10.3+	2014 Employee Stock Purchase Plan.	S-1/A	333-196539	10.3	July 7, 2014
10.4+	2016 Inducement Equity Incentive Plan and forms of award thereunder.	10-Q	001-36540	10.4	November 9, 2016
10.5	Form of Indemnification Agreement.	S-1	333-196539	10.4	June 5, 2014
10.6	Lease Agreement, dated June 22, 2010, between the Registrant and BRS-Tustin Safeguard Associates II, LLC.	S-1	333-196539	10.5	June 5, 2014
10.7	First Amendment to Multi-Tenant Industrial/ Commercial Lease dated September 4, 2014 between the Registrant and BRS-Tustin Safeguard Associates II, LLC.	8-K	001-36540	10.1	September 25, 2014
10.8	Second Amendment to Multi-Tenant Industrial/ Commercial Lease dated November 19, 2015 between the Registrant and BRS-Tustin Safeguard Associates II, LLC.	10-K	001-36540	10.7	March 10, 2016
10.9	Third Amendment to Multi-Tenant Industrial/ Commercial Lease dated February 24, 2016 between the Registrant and BRS-Tustin Safeguard Associates II, LLC.	10-Q	001-36540	10.2	May 9, 2016
10.10†	Technology License Agreement, dated November 30, 2009, between the Registrant and The Dow Chemical Company.	S-1/A	333-196539	10.8	June 25, 2014
10.11	Grant Back License Agreement, dated November 30, 2009, between the Registrant and The Dow Chemical Company.	S-1	333-196539	10.9	June 5, 2014
10.12	Technology Assignment Agreement, dated November 30, 2009, between the Registrant and The Dow Chemical Company.	S-1	333-196539	10.10	June 5, 2014
10.13	Contribution Assignment and Assumption Agreement, dated November 30, 2009, between the Registrant and The Dow Chemical Company.	S-1	333-196539	10.11	June 5, 2014
10.14†	Subcontract Agreement, effective September 11, 2009, between the Registrant, as assignee of The Dow Chemical Company, and Science Applications International Corporation.	S-1/A	333-196539	10.12	June 25, 2014

Exhibit Number	Description	Incorporated by Reference			
		Form	File No.	Exhibit	Filing Date
10.15†	Subcontract Agreement, Modification 21, effective September 12, 2014, between the Registrant, as assignee of The Dow Chemical Company, and Science Applications International Corporation.	10-Q	001-36540	10.4	November 14, 2014
10.16†	Cost Plus Fixed Fee Agreement, dated July 30, 2010, as amended December 18, 2014, between the Registrant and the United States Department of Health and Human Services.	10-K	001-36540	10.15	March 16, 2015
10.17	Modification No. 11, effective January 5, 2015, to Contract Agreement dated July 30, 2010, between the Registrant and the United States Department of Health and Human Services	10-Q	001-36540	10.6	May 14, 2015
10.18	Modification No. 12, effective May 5, 2015, to Contract Agreement dated July 30, 2010, between the Registrant and the United States Department of Health and Human Services.	10-Q	001-36540	10.1	August 13, 2015
10.19	Modification No. 13, effective July 23, 2015, to Contract Agreement dated July 30, 2010, between the Registrant and the United States Department of Health and Human Services.	10-Q	001-36540	10.2	November 13, 2015
10.20†	Modification No. 14, effective October 20, 2015, to Contract Agreement dated July 30, 2010, between the Registrant and the United States Department of Health and Human Services.	10-K	001-36540	10.20	March 10, 2016
10.21†	Modification No. 15, effective March 14, 2016, to Contract Agreement dated July 30, 2010, between the Registrant and the United States Department of Health and Human Services.	10-Q	001-36540	10.4	May 9, 2016
10.22+	Executive Employment Agreement, dated June 20, 2014, between the Registrant and Bertrand C. Liang.	S-1/A	333-196539	10.20	June 23, 2014
10.23+	Executive Employment Agreement, dated June 20, 2014, between the Registrant and Paul A. Wagner.	S-1/A	333-196539	10.21	June 23, 2014
10.24+	Executive Employment Agreement, dated June 20, 2014, between the Registrant and Patricia Lady.	S-1/A	333-196539	10.22	June 23, 2014
10.25+	Executive Employment Agreement, dated June 20, 2014, between the Registrant and Patrick K. Lucy.	S-1/A	333-196539	10.23	June 23, 2014
10.26+	Executive Employment Agreement, dated June 20, 2014, between the Registrant and Henry W. Talbot.	S-1/A	333-196539	10.24	June 23, 2014

Exhibit Number	Description	Incorporated by Reference			
		Form	File No.	Exhibit	Filing Date
10.27+	Executive Employment Agreement, dated November 3, 2014, between the Registrant and Hubert C. Chen.	10-K	001-36540	10.29	March 16, 2015
10.28+	Executive Employment Agreement, dated September 26, 2016, between the Registrant and Steven Sandoval, Sr.	10-Q	001-36540	10.3	November 9, 2016
10.29+	Executive Employment Agreement, dated August 3, 2017, between the Registrant and Evert B. Schimmelpennink.	8-K	001-36540	10.1	August 3, 2017
10.30+	Executive Employment Agreement, effective February 1, 2018, between the Registrant and Susan A. Knudson.	8-K	001-36540	10.1	January 4, 2018
10.31+	Executive Employment Agreement, effective October 1, 2018, between the Registrant and Shawn A. Scranton, PharmD.	8-K	001-36540	10.1	September 11, 2018
10.32+	Separation Agreement and Release by and between the Company and Bertrand C. Liang effective January 23, 2017.	8-K	001-36540	10.1	January 24, 2017
10.33+	Consulting Agreement by and between the Company and Bertrand C. Liang effective January 23, 2017.	8-K	001-36540	10.1	January 24, 2017
10.34+	Mutual Separation Agreement and Mutual Release by and between the Company and Paul Wagner dated September 7, 2017.	8-K	001-36540	10.1	September 7, 2017
10.25+	Consulting Agreement by and between the Company and Paul Wagner effective September 7, 2017.	8-K	001-36540	10.1	September 7, 2017
10.36+	Mutual Separation Agreement and Mutual Release by and between the Company and Steven S. Sandoval, Sr. dated September 7, 2017.	8-K	001-36540	10.3	September 7, 2017
10.37+	Transition Agreement and Release by and between the Company and Hubert C. Chen dated August 16, 2018.	10-Q	001-36540	10.1	November 7, 2018
10.38+	Executive Incentive Compensation Plan.	S-1/A	333-196539	10.27	June 23, 2014
10.39†	Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	S-1/A	333-196539	10.25	June 25, 2014
10.40	Modification No. 3, dated October 31, 2014, to Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	10-K	001-36540	10.32	March 16, 2015
10.41†	Modification No. 4, dated January 5, 2015, to Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	10-K	001-36540	10.33	March 16, 2015

Exhibit Number	Description	Incorporated by Reference			
		Form	File No.	Exhibit	Filing Date
10.42†	Modification No. 5, dated April 5, 2015, to Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	S-1	333-203418	10.34	April 15, 2015
10.43†	Modification No. 6, dated November 2, 2015, to Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	10-K	001-36540	10.43	March 10, 2016
10.44†	Modification No. 7, dated February 22, 2016, to Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	10-Q	001-36540	10.3	May 9, 2016
10.45†	Modification No. 8, dated May 16, 2016, to Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	10-Q	001-36540	10.1	August 8, 2016
10.46†	Modification No. 9, effective September 28, 2016, to Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	10-Q	001-36540	10.2	November 9, 2016
10.47†	Modification No. 10, effective October 31, 2016, to Contract Agreement, dated September 27, 2012, between the Registrant and the National Institutes of Health.	10-K	001-36540	10.53	March 15, 2017
10.48†	Development and License Agreement, dated February 9, 2015, between the Registrant and Hospira Bahamas Biologics Ltd.	S-1/A	333-203418	10.35	April 23, 2015
10.49†	Cost Plus Fixed Fee Agreement, dated August 14, 2015 between the Registrant and the United States Department of Health and Human Services.	10-Q/A	001-36540	10.1	February 23, 2016
10.50†	Modification No. 1, effective October 15, 2015, to Cost Plus Fixed Fee Agreement, dated August 14, 2015, between the Registrant and the United States Department of Health and Human Services.	10-K	001-36540	10.46	March 10, 2016
10.51†	Modification No. 2, effective February 17, 2016, to Cost Plus Fixed Fee Agreement, dated August 14, 2015, between the Registrant and the United States Department of Health and Human Services.	10-Q	001-36540	10.1	May 9, 2016
10.52†	Modification No. 3, effective November 29, 2016, to Cost Plus Fixed Fee Agreement, dated August 14, 2015, between the Registrant and the United States Department of Health and Human Services.	10-K	001-36540	10.58	March 15, 2017

Exhibit Number	Description	Incorporated by Reference			
		Form	File No.	Exhibit	Filing Date
10.53†	Modification No. 4, effective January 9, 2017, to Cost Plus Fixed Fee Agreement, dated August 14, 2015, between the Registrant and the United States Department of Health and Human Services.	10-K	001-36540	10.59	March 15, 2017
10.54†	Modification No. 5, effective August 2, 2017, to Cost Plus Fixed Fee Agreement, dated August 14, 2015, between the Registrant and the United States Department of Health and Human Services.	10-Q	001-36540	10.6	November 9, 2017
10.55†	Modification No. 6, effective May 15, 2018, to Cost Plus Fixed Fee Agreement, dated August 14, 2015, between the Registrant and the United States Department of Health and Human Services.	10-Q	001-36540	10.2	August 8, 2018
10.56†	Modification No. 7, effective September 14, 2018, to Cost Plus Fixed Fee Agreement, dated August 14, 2015, between the Registrant and the United States Department of Health and Human Services.	10-Q	001-36540	10.2	November 7, 2018
10.57†	License and Option Agreement, dated July 27, 2016, by and between the Registrant and Jazz Pharmaceuticals Ireland Limited.	10-Q	001-36540	10.1	November 9, 2016
10.58†	Amended License and Option Agreement, dated December 19, 2017, by and between the Registrant and Jazz Pharmaceuticals Ireland Limited.	10-K/A	001-36540	10.68	June 6, 2018
10.59†	Development and License Agreement, dated April 18, 2018, by and between the Registrant and China NT Pharma Group Company Ltd	10-Q	001-36540	10.1	August 8, 2018
10.60†	Development and License Agreement, dated June 11, 2018, by and between the Registrant and Alvogen Malta Operations Ltd.	10-Q	001-36540	10.3	August 8, 2018
10.61	Sales Agreement, dated as of March 15, 2018, between Pfenex Inc. and William Blair & Company, L.L.C.	8-K	001-36540	1.1	March 15, 2018
23.1*	Consent of KPMG LLP, Independent Registered Public Accounting Firm.				
24.1*	Power of Attorney (contained on signature page).				
31.1*	Certification of Chief Executive Officer pursuant to Exchange Act Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.				

Exhibit Number	Description	Incorporated by Reference			
		Form	File No.	Exhibit	Filing Date
31.2*	Certification of Chief Financial Officer pursuant to Exchange Act Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.				
32.1^	Certifications of Chief Executive Officer and Chief Financial Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.				
101.INS*	XBRL Instance Document.				
101.SCH*	XBRL Taxonomy Extension Schema Document.				
101.CAL*	XBRL Taxonomy Extension Calculation Linkbase Document.				
101.DEF*	XBRL Taxonomy Extension Definition Linkbase Document				
101.LAB*	XBRL Taxonomy Extension Label Linkbase Document				
101.PRE*	XBRL Taxonomy Extension Presentation Linkbase Document				

* Filed herewith.

^ The information in this exhibit is furnished and deemed not filed with the Securities and Exchange Commission for purposes of section 18 of the Exchange Act of 1934, as amended (Exchange Act), and is not to be incorporated by reference into any filing of Pfenex Inc. under the Securities Act of 1933, as amended (Securities Act), or the Exchange Act, whether made before or after the date hereof, regardless of any general incorporation language in such filing.

† Portions of the exhibit have been omitted pursuant to an order granted by the Securities and Exchange Commission for confidential treatment.

\+ Indicates a management contract or compensatory plan.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this Annual Report on Form 10-K to be signed on its behalf by the undersigned, thereunto duly authorized.

Date: March 11, 2019

Pfenex Inc.

By: /s/ Evert B. Schimmelpennink
Evert B. Schimmelpennink
Chief Executive Officer, President, Secretary, and Director
(Principal Executive Officer)

POWER OF ATTORNEY

Each person whose signature appears below constitutes and appoints Evert B. Schimmelpennink and Susan A. Knudson, and each of them, as his or her true and lawful attorney-in-fact and agent to act, with full power of substitution and resubstitution, for him or her and in his or her name, place and stead, in any and all capacities, and to sign any and all amendments to this Annual Report on Form 10-K, and to file the same, with all exhibits thereto, and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents, and each of them, full power and authority to do and perform each and every act and thing requisite and necessary to be done in connection therewith, as fully to all intents and purposes as he or she might or could do in person, hereby ratifying and confirming all that said attorneys-in-fact and agents, or any of them, or their and his or her substitutes, may lawfully do or cause to be done by virtue thereof.

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:

Signature	Title	Date
/s/ Evert B. Schimmelpennink Evert B. Schimmelpennink	Chief Executive Officer, President, Secretary, and Director *(Principal Executive Officer)*	March 11, 2019
/s/ Susan A. Knudson Susan A. Knudson	Chief Financial Officer *(Principal Financial and Accounting Officer)*	March 11, 2019
/s/ Jason Grenfell-Gardner Jason Grenfell-Gardner	Chairman and Director	March 11, 2019
/s/ Robin D. Campbell Robin D. Campbell	Director	March 11, 2019
/s/ Phillip M. Schneider Phillip M. Schneider	Director	March 11, 2019

Signature	Title	Date
/s/ John Taylor John Taylor	Director	March 11, 2019
/s/ Sigurdur Olafsson Sigurdur Olafsson	Director	March 11, 2019
/s/ Magda Marquet Magda Marquet	Director	March 11, 2019

BOARD OF DIRECTORS

Jason Grenfell-Gardner
Chairman
President, Chief Executive Officer and Director of Teligent, Inc.

Evert B. Schimmelpennink
Chief Executive Officer, President and Secretary of Pfenex Inc.

Robin D. Campbell, Ph.D.
Former President and Chief Executive Officer of Naryx Pharma, Inc.

Magda Marquet, Ph.D.
Co-Chief Executive Officer of ALMA Life Sciences LLC

Sigurdur Olafsson
Chief Executive Officer of Hikma Pharmaceuticals PLC

Phillip M. Schneider
Former Senior Vice President and Chief Financial Officer of IDEC Pharmaceuticals Corporation

John M. Taylor
President and Principal of Compliance and Regulatory Affairs of Greenleaf Health LLC

CORPORATE OFFICERS

Evert B. Schimmelpennink
Chief Executive Officer, President and Secretary

Susan A. Knudson
Senior Vice President and Chief Financial Officer

Patrick K. Lucy
Senior Vice President and Chief Business Officer

Shawn A. Scranton, PharmD
Senior Vice President and Chief Operating Officer

Martin B. Brenner, DVM, Ph.D.
Senior Vice President and Chief Scientific Officer

CORPORATE HEADQUARTERS

Pfenex Inc.
10790 Roselle St.
San Diego, CA 92121
T: (858) 352-4400
F: (858) 352-4602
www.pfenex.com

COMMON STOCK LISTING

NYSE American
Ticker Symbol: PFNX

ANNUAL MEETING OF STOCKHOLDERS

May 9, 2019 at 12:00 p.m. Pacific Time
Offices of Wilson Sonsini Goodrich & Rosati, P.C.
12235 El Camino Real
San Diego, CA 92130

REGISTRAR AND TRANSFER AGENT

For questions regarding your account, changes of address or the consolidation of accounts, please contact the Company's transfer agent:

American Stock Transfer & Trust Company, LLC
6201 15th Avenue
Brooklyn, NY 11219
Attn: Shareholder Services
T: (800) 937-5449
www.amstock.com

LEGAL COUNSEL

Wilson Sonsini Goodrich & Rosati,
Professional Corporation
San Diego, California

INDEPENDENT AUDITORS

KPMG LLP
San Diego, California

INVESTOR RELATIONS

Pfenex Inc.
Investor Relations
10790 Roselle St.
San Diego, CA 92121
T: (858) 352-4400
E: investors@pfenex.com

PFEnex