

Xenon Pharmaceuticals Inc.
Form 10-K
March 08, 2016

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, 2015

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: 001-36687

XENON PHARMACEUTICALS INC.

(Exact Name of Registrant as Specified in its Charter)

Canada 98-0661854
(State or other jurisdiction (I.R.S. Employer

of incorporation or organization) Identification Number)

200 – 3650 Gilmore Way

Burnaby, British Columbia V5G 4W8

Canada

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(Address of Principal Executive Offices, including zip code)

(Registrant's Telephone Number, Including Area Code): (604) 484-3300

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

Title of Each Class	Name of Exchange on Which Registered
Common Shares, no par value per share	The NASDAQ Stock Market LLC (The NASDAQ Global Market)

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

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

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or 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 and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted 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 and post such files). Yes No

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

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

Large accelerated filer Accelerated filer

Non-accelerated filer Smaller reporting company

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Securities Exchange Act of 1934). Yes No

The aggregate market value of the voting and non-voting common shares held by non-affiliates of the registrant, based on the closing sale price of the registrant's common shares on the last business day of its most recently completed second fiscal quarter, as reported on The NASDAQ Global Market, was approximately \$141 million. Common shares

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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. This determination of affiliate status is not necessarily a conclusive determination for other purposes.

The number of outstanding common shares of the registrant, no par value per share, as of March 4, 2016 was 14,401,582.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's definitive Proxy Statement to be filed with the Securities and Exchange Commission in connection with the registrant's 2016 Annual Meeting of Shareholders, which will be filed subsequent to the date hereof, are incorporated by reference into Part III of this Form 10-K. Such Proxy Statement will be filed with the Securities and Exchange Commission not later than 120 days following the end of the registrant's fiscal year ended December 31, 2015.

XENON PHARMACEUTICALS INC.

FORM 10-K

For the Fiscal Year Ended December 31, 2015

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PART I

Forward-Looking Statements

Certain statements contained in this Annual Report on Form 10-K may constitute 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 and Canadian securities laws. The words or phrases “would be,” “will allow,” “intends to,” “may,” “believe,” “plan,” “will likely result,” “are expected to,” “will continue,” “is anticipated,” “estimate,” “project,” or similar expressions or the negative of such words or phrases, are intended to identify “forward-looking statements.” You should read these statements carefully because they discuss future expectations, contain projections of future results of operations or financial condition, or state other “forward-looking” information. These statements relate to our future plans, objectives, expectations, intentions and financial performance and the assumptions that underlie these statements. These forward-looking statements include, but are not limited to:

- our ability to identify additional products or product candidates using our Extreme Genetics discovery platform;
- the initiation, timing, cost, progress and success of our research and development programs, preclinical studies and clinical trials;
- our ability to advance product candidates into, and successfully complete, clinical trials;
- our ability to recruit sufficient numbers of patients for our current and future clinical trials for orphan or more common indications;
- our ability to achieve profitability;
- our ability to obtain funding for our operations, including research funding;
- our ability to receive milestones, royalties and sublicensing fees under our collaborations, and the timing of such payments;
- the implementation of our business model and strategic plans;
- our ability to develop and commercialize product candidates for orphan and niche indications independently;
- our commercialization, marketing and manufacturing capabilities and strategy;
- our ability to find families to support our Extreme Genetics discovery platform;
- our ability to discover genes and drug targets;
- our ability to protect our intellectual property and operate our business without infringing upon the intellectual property rights of others;
- our expectations regarding federal, state and foreign regulatory requirements;
- the therapeutic benefits, effectiveness and safety of our product candidates;
- the accuracy of our estimates of the size and characteristics of the markets that may be addressed by our products and product candidates;
- the rate and degree of market acceptance and clinical utility of Glybera and future products, if any;
- the timing of, and our and our collaborators’ ability to obtain and maintain regulatory approvals for our product candidates;
- our ability to maintain and establish collaborations;
- our expectations regarding market risk, including interest rate changes and foreign currency fluctuations;
- our belief in the sufficiency of our cash flows to meet our needs for at least the next 12 to 24 months;
- our ability to engage and retain the employees required to grow our business;
- our future financial performance and projected expenditures;
- developments relating to our competitors and our industry, including the success of competing therapies that are or become available; and
- estimates of our expenses, future revenue, capital requirements and our needs for additional financing.

These forward-looking statements are subject to certain risks and uncertainties that could cause actual results to differ materially from those anticipated in the forward-looking statements. Factors that might cause such a difference include, but are not limited to, those discussed in this report in Part I, Item 1A — “Risk Factors,” and elsewhere in this report. Forward-looking statements are based on our management’s beliefs and assumptions and on information currently available to our management. These statements, like all statements in this report, speak only as of their date, and we undertake no obligation to update or revise these statements in light of future developments. In this report, “we,” “our,” “us,” “Xenon,” and “the Company” refer to Xenon Pharmaceuticals Inc. Unless otherwise noted, all dollar amounts in this report are expressed in United States dollars.

This Annual Report on Form 10-K includes our trademarks and registered trademarks, including the Xenon logo, “Extreme Genetics” and other trademarks or service marks of Xenon. Each other trademark, trade name or service mark appearing in this Annual Report on Form 10-K belongs to its holder.

Item 1. Business

Overview

We are a clinical-stage biopharmaceutical company discovering and developing a pipeline of differentiated therapeutics for orphan indications that we intend to commercialize on our own, and for larger market indications that we intend to partner with global pharmaceutical companies. We have built a core enabling discovery platform for the discovery of validated drug targets by studying rare human diseases with extreme traits, including diseases caused by mutations in ion channels, known as channelopathies. We have an integrated platform that includes in-house capabilities for human genetics, small molecule drug discovery, as well as preclinical and clinical development.

Our pharmaceutical partners include Teva Pharmaceutical Industries, Ltd., or Teva (through its subsidiary, Ivax International GmbH), Genentech, Inc., or Genentech, and Merck & Co., Inc., or Merck (through its affiliate, Essex Chemie AG). Our pharmaceutical collaborations have generated in aggregate over \$155.0 million in non-equity funding to date with the potential to provide us with over \$1.0 billion in future milestone payments, as well as royalties and co-promotion income on product sales.

Our business was founded on our proprietary discovery platform, which we refer to as Extreme Genetics. Extreme Genetics involves the study of families where individuals exhibit inherited severe traits, or phenotypes. By identifying and characterizing single-gene defects responsible for these phenotypes, we gain insights into human disease biology to better select targets for therapeutic intervention. We believe that our Extreme Genetics discovery platform enhances the likelihood of discovering a drug target that has a major effect in humans. From these discoveries, we can gain an improved understanding of how a drug that modulates the target might act when given to a human.

Our Extreme Genetics discovery platform has yielded the first approved gene therapy product in the European Union, or the EU, and a broad proprietary development pipeline and multiple pharmaceutical partnerships, which include:

- Glybera, developed by our licensee uniQure Biopharma B.V., or uniQure, the first, and currently the only, gene therapy product approved in the EU for the treatment of the orphan disorder lipoprotein lipase deficiency, or LPLD. The first patient treated with Glybera as a commercially-available gene therapy was announced by uniQure in November 2015 and enabled by its commercialization partner in the EU, Chiesi Farmaceutici S.p.A., or Chiesi, which has sole control over commercialization in the EU;
- TV-45070 (formerly XEN402), a product candidate being developed in collaboration with Teva for the treatment of pain. Teva is currently conducting a randomized, double-blind, placebo-controlled Phase 2b clinical trial in patients with post-herpetic neuralgia, or PHN, with results expected in the second half of 2016. TV-45070 is a topically applied small-molecule inhibitor of the sodium channel Nav1.7 and other sodium channels, including those that are expressed in the pain-sensing peripheral nervous system;

- GDC-0276 and GDC-0310, which are both oral, selective Nav1.7 small-molecule inhibitors being developed in collaboration with Genentech for the potential treatment of pain. Phase 1 clinical trials for GDC-0276 and GDC-0310 are ongoing, and pending a full assessment of the results, Genentech intends to initiate a Phase 2 clinical trial in 2016. Xenon and Genentech also have an active research collaboration focused on other orally selective small molecule inhibitors of Nav1.7;
- XEN801, a stearoyl Co-A desaturase-1, or SCD1, inhibitor being developed for the treatment of acne. SCD1 is an enzyme involved in lipid synthesis that is expressed in sebaceous glands in the skin. We have completed a Phase 1 clinical trial for XEN801 and initiated a Phase 2 clinical trial in February 2016 in patients with moderate to severe facial acne. We anticipate topline results in the fourth quarter of 2016; and

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- additional proprietary preclinical programs, including a Nav1.6 sodium channel inhibitor for the treatment of rare childhood epilepsy disorders, such as Dravet Syndrome, or DS, an orphan disease of severe childhood epilepsy. We expect to identify a development candidate in 2016 and file an investigational new drug, or IND, application for our Nav1.6 inhibitor in the first half of 2017.

Our Strategy

Our goal is to build a self-sustaining, fully-integrated and profitable company that discovers, develops and commercializes innovative therapeutics, including novel selective ion channel inhibitors, by applying our expertise in the genetics of rare human diseases.

Since our inception, we believe we have operated in a capital-efficient manner to build our capabilities and assets through phased growth, expansion and value creation. Prior to our November 2014 initial public offering and concurrent private placement, our last equity financing was in 2006. From 2006 to November 2014, we funded our operations and expanded our platform, product pipeline and infrastructure through a strategy which combined the deployment of our own resources and the establishment of broadly enabling and well-structured pharmaceutical partnerships with industry leaders.

Our strategy includes:

- Expanding our pipeline and advancing multiple discovery and development programs, focusing on orphan and niche disease market opportunities that we can independently develop and commercialize ourselves.
- Selectively establishing additional partnerships enabling us to access large commercial indications while leveraging the benefits of those collaborations to expand our internal capabilities.
- Further leveraging our discovery platform and insights into disease biology to identify novel targets and develop next-generation products.

Our Extreme Genetics Discovery Platform

Despite advances in medical sciences and the pharmaceutical industry's understanding of diseases, research and development productivity in the industry has declined over the years. We believe that a contributor to this problem is the industry's reliance on drug discovery approaches that are sometimes based on targets that do not necessarily have a major biological effect in humans. Consequently, it is fairly common for a pharmaceutical company to invest substantial time, resources and funds into drug development only to realize in late-stage clinical trials that a product candidate may be directed to a target that is either not biologically relevant to the disease or that may have diverse functions or effects in humans, thereby leading to poor efficacy or safety.

Our Extreme Genetics discovery platform enables us to identify drug targets that may be more biologically relevant in humans. Our platform is built on the foundation of identifying and studying rare individuals and families with severe phenotypes to discover single-gene defects that have major biological effects in humans. By studying these individuals and families with severe phenotypes, we can obtain critical insights into the genes underlying these diseases and their related biology to develop promising product candidates. We therefore are able to initiate our drug discovery efforts with the advantage of having a greater understanding of the role of the drug target in human disease.

The selection of suitable families with rare phenotypes is integral to our successful identification of single-gene defects. Such families are rare and dispersed throughout the world, which makes accessing and studying such families a challenge. We have developed internal clinical genetics expertise allowing us to identify and access rare families. To date, we have established a global network that has included more than 30 clinical collaborations in multiple countries. We collect DNA and detailed clinical information from the selected families to which we then apply our in-house genetics, molecular biology and bioinformatics capabilities to identify the single-gene defect. Using these genetic insights, we apply our in-house, small-molecule expertise as well as access other therapeutic modalities, with

the goal of developing novel medicines.

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Our reliance on our Extreme Genetics discovery platform for target selection differs from other target selection methods commonly employed in the industry, such as in vitro cell biology and screening, tissue and differential expression studies, in vitro and animal based pharmacology and the use of animal models, such as gene knock-outs or animal transgenics. Some companies, however, do use human genetics to varying degrees to assist with target identification, such as approaches where larger populations of patients and controls are studied to define associations where a disease and single nucleotide polymorphisms, or SNPs, in certain genes are linked. While SNP associations allow the identifications of genes that show an association with a disease or may increase risk of disease, such associations differ from our Extreme Genetics discovery platform since they do not discover genes that are determinant or causal of a disease. By studying families with rare diseases where individuals present with severe phenotypes, we seek to isolate the genetic cause of such diseases. We then use this causal information as our primary methodology underlying our target discovery and selection.

The key components of our Extreme Genetics discovery platform include:

- clinical geneticists and genetic counselors with a deep understanding of clinical phenotypes. These experts identify the rare genetic disorders with severe phenotypes that we study;
 - years of experience and extensive know-how in successfully navigating through regulations in multiple countries in order to obtain the approvals necessary to collect and use detailed clinical information and DNA samples from individuals and families with severe phenotypes;
 - internal capabilities in genome sequencing, molecular biology and bioinformatics to enable identification of single-gene defects and validation of these as potential drug targets;
 - expertise in small-molecule drug discovery to design promising product candidates that effectively modulate the identified drug targets. Our drug discovery capabilities include medicinal and synthetic chemistry, assay development and in vitro and in vivo pharmacology; and
 - an established global network that has included more than 30 clinical collaborators in multiple countries, and which has provided us with access to rare individuals and families with severe phenotypes dispersed throughout the world.
- In addition, Xenon has built upon our global network by developing a new direct-to-patient web-based recruitment approach for identifying patients with rare or extreme phenotypes. By leveraging social media tools and allowing potential participants to directly access research studies online, we have successfully broadened the recruitment of participants for several of our research studies.

Focus on Human Channelopathies

A significant focus of our Extreme Genetics discovery platform has been human channelopathies, enabling us to develop strong capabilities in small molecule ion channel drug discovery. Our ion channel discovery capability is founded upon our understanding of the genetics of channelopathies combined with our proprietary biology and medicinal chemistry assets and know-how. We identified new binding sites on ion channels which, in turn, led to the discovery of highly-selective voltage-gated ion channel inhibitors which may have safety and efficacy advantages over non-selective inhibitors.

While the pharmaceutical industry has shown significant interest in channelopathies, a general inability to target ion channels selectively with a pharmaceutical agent has been a limitation to the development of effective therapeutics. We believe we have developed a core competence in developing highly-selective small-molecule ion channel inhibitors, and we believe we can use this know-how to develop a pipeline of novel ion channel inhibitors for diseases in areas of high unmet medical need.

For example, we discovered that deficiency of the voltage-gated sodium channel Nav1.7 is present in the rare human disease called congenital indifference to pain, or CIP. Individuals with CIP are unable to feel pain. This relationship indicated that Nav1.7 may be a key mechanism for the development of novel analgesics. We are pursuing this

mechanism in separate partnerships with Teva and with Genentech.

Similarly, with our collaborators from McGill University, we identified the genetic link between rare human epilepsies and mutations in the Nav1.1 sodium channel. These genetic epilepsy discoveries helped to define our therapeutic selective ion channel strategy for DS and other rare childhood epilepsies. We believe that our Extreme Genetics discovery platform provides the opportunity to validate additional ion channel targets for both prevalent and orphan indications.

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Our Pipeline

Our pipeline is summarized in the following figure, which shows both our partnered programs and our own proprietary product candidates:

Our Partnered Programs

Glybera (alipogene tiparvovec): A Gene Therapy for the Orphan Disease LPLD

Glybera is a gene therapy product approved in the EU in October 2012 for the treatment of a subset of patients with the orphan lipid disorder lipoprotein lipase deficiency, or LPLD. Specifically, it is intended to treat LPLD in patients with severe or multiple pancreatitis attacks, despite dietary fat restrictions. LPLD is a severe metabolic disease of inadequate lipid metabolism, resulting in pancreatitis and in some cases, death. In collaboration with the University of British Columbia, or UBC, we demonstrated that humans with a variant of the lipoprotein lipase, or LPL, gene called LPL^{S447X} resulted in increased LPL enzyme activity leading to reduced triglyceride levels. Under our sublicense and research agreement with uniQure, we collaborated with uniQure and UBC on preclinical activities, and thereafter uniQure developed a LPL gene therapy product, Glybera, which contains the LPL^{S447X} variant. We believe that the introduction of the therapeutic LPL^{S447X} gene through administration of Glybera provides a clinical benefit for LPLD patients.

Glybera is the first product whose active ingredient was derived from our platform to receive commercial approval and is the first gene therapy product to be approved in the EU. The goal of Glybera therapy is to treat LPLD in order to achieve sustained improvement of clearance of triglyceride-rich lipid particles known as chylomicrons, and to significantly reduce the risk of pancreatitis attacks in patients suffering from multiple recurrent pancreatitis and abdominal pain events.

About LPLD

Familial LPLD is a rare autosomal-recessive disorder of lipoprotein metabolism. LPLD is characterized by severe hypertriglyceridemia caused by the absence of LPL activity, and, as a consequence, certain triglyceride-rich lipoproteins accumulate in the plasma. The population frequency of LPLD in the U.S. has been reported to be approximately one in a million individuals by the National Library of Medicine.

LPLD typically manifests early in childhood, with repeated episodes of abdominal pain and acute pancreatitis that can be life-threatening. There is currently no approved gene therapy for LPLD in the U.S. The current management of LPLD consists of strict adherence to an extremely low-fat diet, but compliance with such a diet is challenging. Lipid-lowering drugs are generally not effective for treating LPLD. We believe effective therapeutic strategies are therefore needed for this condition.

About LPL^{S447X}

Together with our collaborators at UBC and using our Extreme Genetics discovery platform, we demonstrated that the LPL^{S447X} variant resulted in reduced triglyceride levels in humans, as this single-gene defect results in elevated LPL enzyme activity, and we further demonstrated that LPL^{S447X} in an adenovirus gene therapy could treat hypertriglyceridemia in animal models of LPLD.

Clinical Development of Glybera

In a scientific publication, a single dose of Glybera was well-tolerated with no material safety concerns and was demonstrated to reduce the incidence of acute pancreatitis and abdominal pain events over the two-year study period.

Commercialization of Glybera

In 2012, Glybera was approved in the EU for the orphan disorder LPLD to treat patients with severe or multiple pancreatitis attacks. In July 2013, uniQure announced that it had entered into a partnership with Chiesi for the commercialization of Glybera in the EU and more than a dozen other countries including Brazil, China, Mexico and Russia. Glybera has received both fast-track and orphan drug designations for the treatment of LPLD in both the EU and the U.S. The first patient treated with Glybera as a commercially-available gene therapy in the EU was announced by uniQure in November 2015. Although commercial sales of Glybera have now commenced, we do not expect to receive significant revenue in the near-term from these sales. uniQure also disclosed in November 2015 that it will not pursue U.S. regulatory approval of Glybera in order to maintain its focus on three core therapeutic areas. uniQure has announced that it will not provide additional guidance regarding commercialization progress for Glybera. For a more detailed description of the terms of our agreement with uniQure for Glybera, see “—Strategic Alliances” below.

TV-45070: A Small Molecule for the Treatment of Pain

TV-45070 (formerly XEN402) is a small-molecule inhibitor of the sodium channel Nav1.7 and other sodium channels, including those that are expressed in the pain-sensing peripheral nervous system. TV-45070 has potential application in neuropathic pain mediated by damage, dysfunction, or injury of nerves. TV-45070 is partnered with Teva. Using a topical ointment formulation of TV-45070, Teva is currently conducting a randomized, double-blind, placebo-controlled Phase 2b clinical trial in patients with PHN with results expected in the second half of 2016. Pursuant to the terms of our agreement with Teva, Teva is obligated to complete one additional Phase 2 or later stage clinical trial.

We selected Nav1.7 as a drug target for pain after we discovered that the Nav1.7 protein is deficient in the rare human disease, CIP, where humans suffering from CIP are unable to feel pain. We have observed promising evidence of activity for TV-45070 in four Phase 2 proof-of-concept clinical trials, including two trials in the orphan disease erythromelalgia, or EM, one trial in PHN and one trial in dental pain, a form of nociceptive pain. In December 2012, we entered into a collaborative development and license agreement with Teva through its subsidiary Ivax, pursuant to which we granted Teva an exclusive worldwide license to develop and commercialize TV-45070. For a more detailed description of the terms of our agreement with Teva, see “—Strategic Alliances” below. Prior to our entry into a collaborative development and license agreement with Teva, we submitted INDs to the FDA for oral TV-45070 for the indication of dental pain (July 2009) and topical TV-45070 for the indication of acute and chronic pain, including neuropathic and inflammatory pain (July 2010). Teva submitted an IND to the FDA for topical TV-45070 for the symptomatic treatment of osteoarthritis, or OA (November 2013).

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Discovery of TV-45070 and Mechanism of Action

Using our Extreme Genetics discovery platform, we discovered Nav1.7 by studying families with the rare disorder CIP. Patients with CIP are unable to feel pain for painful events including fractures, childbirth, osteomyelitis, severe burns, ulcers, wounds and tooth abscesses. Based on this severe phenotype of absence of pain in humans with CIP, we predicted that the single-gene defect causing CIP could define an important novel human drug target for treating pain. We showed that defects in the CIP gene result in deficiency of the sodium channel Nav1.7.

Nav1.7 is highly expressed in peripheral nerves and transmits pain signals. We believe that inhibition of Nav1.7 may reduce these pain signals. TV-45070 was designed to be a non-selective small-molecule inhibitor of Nav1.7 such that it also can inhibit additional sodium channels, including those that we believe play a role in pain signaling. We believe this mixed sodium channel inhibition may enhance the potential efficacy of TV-45070 in chronic pain. TV-45070 is currently being developed as a topical product as its chemical properties are favorable for topical administration, including high local skin and underlying tissue concentrations with low plasma levels. With these properties, we believe we can target the site of generation of peripherally-based pain without unnecessarily exposing other tissues to significant levels of this compound. This is especially true for the central nervous system where we might expect to observe side-effects when multiple sodium channels are inhibited, such as sleepiness, nausea, and dizziness. We have demonstrated efficacy with this compound in multiple animal models for pain including both nociceptive and neuropathic pain models. The broad sodium channel inhibition of TV-45070 is in contrast to our selective inhibitors licensed to Genentech, which are selective for Nav1.7 and are being developed as oral formulations.

Clinical Development of TV-45070

We are collaborating with Teva on the development of topical TV-45070. Topical and oral formulations of TV-45070 have been studied in Phase 1 clinical trials in healthy volunteers, four Phase 2 proof-of-concept clinical trials, a Phase 2b clinical trial in OA of the knee, and an ongoing Phase 2b clinical trial in PHN, with data expected in the second half of 2016. Pursuant to the terms of our agreement with Teva, they are obligated to complete one additional Phase 2 or later stage clinical trial.

TV-45070 Phase 1 Clinical Trials

In a topical Phase 1 study, 20 healthy volunteers were dosed once daily for 21 days with 4% and 8% ointment, placebo, a positive control and a 0.9% saline negative control. Topical TV-45070 was generally well tolerated with no clinically meaningful difference observed between cumulative skin irritation scores for 4% and 8% ointment, placebo and the negative saline control. The positive control as expected did show greater skin irritation; there were no serious adverse events, or SAEs, or deaths in this study. All adverse events were moderate or mild in severity with the majority of adverse events related to local skin reactions from the occlusive tape dressings. The most frequently reported adverse events which were not local skin reactions were headache, dizziness, fatigue, and oropharyngeal pain. Importantly the average plasma concentrations of TV-45070 were low and, as would be expected, central nervous system side effects were of low incidence.

To better understand the systemic side effect profile of TV-45070, the drug was also dosed in Phase 1 single and multiple ascending dose studies using a simple liquid-filled capsule for oral administration. The single-ascending dose, or SAD, study was carried out in 38 healthy volunteers dosed up to 800 mg. The multi-ascending dose, or MAD, study was performed in 32 healthy volunteers who were dosed up to 400 mg twice daily for 5.5 days. The maximal tolerated dose, or MTD, for SAD study was 500 mg and dose-limiting toxicity included dizziness and drowsiness observed for the 800 mg single dose, which we believe indicates inhibition of central nervous system expressed sodium channels. The MTD in the MAD study was not achieved and occasional short-lived adverse events of mild to moderate dizziness and drowsiness were reported by some subjects for the 400 mg twice daily dose.

TV-45070 Phase 2 Proof-of-Concept Clinical Trials

Based on the potential broad utility of TV-45070, prior to our collaboration with Teva, we conducted four Phase 2 proof-of-concept trials to explore the potential of TV-45070 as a treatment for both nociceptive and neuropathic pain, as well as providing evidence that TV-45070 can block the pain signaling mediated by Nav1.7. These trials included: (1) an oral Phase 2 clinical trial in third molar tooth extraction; (2) an oral Phase 2 clinical trial in the orphan indication EM; (3) a topical Phase 2 clinical trial in EM; and, (4) a topical Phase 2 clinical trial in PHN.

We conducted a trial for third molar tooth extraction, which is an established acute inflammatory pain model. We performed a randomized, double-blind, placebo-controlled, Phase 2 proof-of-concept trial in 61 healthy male subjects, of which, 41 subjects received a single oral 500 mg dose of TV-45070 and 20 subjects received placebo. Oral TV-45070 was well-tolerated with no SAEs. The most frequently reported adverse events were nausea, dizziness, headache and drowsiness, which were mild or moderate in intensity. The primary and all secondary endpoints showed consistent trends in favor of reduced pain for TV-45070 versus placebo. The primary efficacy endpoint was the change in total pain relief at six hours post-dose. TV-45070-treated subjects experienced greater pain relief compared to subjects who received placebo ($p=0.171$), although the difference did not achieve the pre-defined statistical significance for the trial of $p=0.1$. In a post-hoc analysis, a significantly increased proportion of TV-45070-treated patients reported 30% or greater ($p<0.05$) and 50% or greater ($p<0.05$) reduction in their pain compared to placebo.

TV-45070 was studied in both a topical formulation and an oral formulation in small, exploratory Phase 2 proof-of-concept clinical trials in primary EM. EM is a disorder of severe neuropathic pain where, in certain families, mutations causing increased activity of the Nav1.7 sodium channel have been identified. The disorder is characterized by recurrent flares of intense burning pain with redness of the skin in the feet, hands or both. We conducted a randomized, double-blind, placebo-controlled, two-period crossover design trial with four subjects comparing oral TV-45070 to placebo each administered twice per day for a duration of two days. In one treatment period, subjects received TV-45070 (400 mg bid), and in the other treatment period, subjects received placebo. The order in which the subjects received each treatment was randomized. In this oral Phase 2 EM trial, a significant (42%) reduction in pain in the two hours following an induced EM flare was observed in the three patients where pain was induced ($p=0.014$). There were no SAEs in this trial and the most frequently reported adverse events were dizziness, headache, sedation and drowsiness, which ranged from mild to severe.

We also conducted a randomized, double-blind, placebo-controlled design trial with eight subjects (seven TV-45070 and one placebo) comparing topical 8% TV-45070 to placebo applied two times per day to the feet for a duration of 14 or 21 days. Throughout the trial, TV-45070 plasma concentrations were low and TV-45070 was well-tolerated. There was no treatment-related dizziness and drowsiness and there were no treatment-related SAEs. Local application site reactions were the most common drug-related adverse events observed. In this topical Phase 2 EM trial, three of seven patients (43%) on TV-45070 showed consistent clinically meaningful reductions in induced and daily pain compared to baseline, while the four remaining TV-45070-treated and placebo-treated subjects were considered to be non-responders based on their magnitude of response or inconsistent response or both. Also, four of six (67%) patients on TV-45070 who used rescue cooling showed a reduction in cooling usage compared to baseline and six of seven (86%) patients on TV-45070 had an improvement in sleep interference scores compared to baseline. This small exploratory trial was not designed to reach statistical significance and no such statistical significance was found. Although we and Teva have evaluated the opportunity to develop TV-45070 as a treatment for EM, Teva is currently focused on the development of TV-45070 for larger market opportunities, such as PHN, and has no current development plans for TV-45070 in EM.

We conducted a Phase 2 proof-of-concept trial of topical TV-45070 in 70 PHN patients. Patients enrolled into the study had refractory PHN and their average disease duration was 76.6 months. This study was a double-blind, placebo-controlled, crossover trial where topical (8% ointment) TV-45070 was administered twice daily with each patient receiving either TV-45070 or placebo for three weeks, then after a washout period, the subjects received the alternative treatment. In this study, Topical TV-45070 was well-tolerated with no drug-related SAEs. The results showed there was a reduction in the primary efficacy endpoint (change from baseline in the mean daily pain score) for both TV-45070 and placebo, but the difference between treatments was not statistically significant. In analysis of certain secondary endpoints, there was a significantly increased proportion of TV-45070-treated patients who reported 30% or greater ($p=0.049$) and 50% or greater ($p=0.0078$) reduction in their pain compared to placebo and a retrospective exploratory analysis not described in the study protocol showed that a significant increased proportion of TV-45070-treated patients reported 30% or greater improvement in sleep ($p=0.034$) compared to placebo. There is a

relatively common genetic variant of Nav1.7 called the R1150W gene variant. We genotyped a subset of the PHN trial subjects for R1150W status to explore if the variant could predict a greater likelihood of response to TV-45070 due to its inhibition of Nav1.7. Although it was not a pre-selected endpoint of the trial, a trend towards greater response to TV-45070 was observed in R1150W-carriers versus non-carriers, as five out of the eight evaluable subjects (63%) had a 30% or greater reduction in their pain when treated with TV-45070. TV-45070 plasma concentrations were low and TV-45070 was well-tolerated with no drug-related SAEs. No drug-related centrally mediated side effects of dizziness and drowsiness were observed in this study. In addition, while on topical TV-45070, PHN patients reported reduced site application pain (3% TV-45070 versus 16% placebo) and less pruritus, or itch, (3% TV-45070 versus 13% placebo) compared to while on placebo treatment. Chronic itch is an important co-morbidity for many PHN patients. The most frequently reported AEs included local application site reactions, nasopharyngitis and urinary tract infections.

TV-45070 Phase 2b Clinical Trial in OA

Using a topical (4% and 8% ointment) formulation of TV-45070, Teva completed a 300-patient, double-blind, placebo-controlled, randomized Phase 2b clinical trial designed to evaluate the safety and efficacy of topically applied TV-45070 in patients with chronic pain due to OA of the knee. In July 2015, we and Teva announced top line results showing that TV-45070 did not demonstrate statistically significant difference from placebo in efficacy endpoints of reductions in pain due to OA. However, TV-45070 did demonstrate a favorable safety and tolerability profile, with no drug-related SAEs. The most common adverse events were application site dermal skin reactions which were mostly mild and less frequent than seen with other topical analgesics. There were no cardiac or central nervous system safety issues. There are no plans for further development of TV-45070 in OA and future clinical development of TV-45070 is focused on neuropathic pain, including PHN.

TV-45070 Phase 2b Clinical Trial in PHN

Based on the encouraging data from our Phase 2 proof-of-concept trial in PHN, Teva is currently conducting a larger Phase 2b trial in patients with PHN. The rationale supporting the development of TV-45070 in PHN includes:

- We observed promising efficacy findings in our PHN Phase 2 proof of concept trial.
- We observed improved responder rates for carriers of the R1150W variant in our PHN Phase 2 proof of concept trial.
- Topical TV-45070 has exhibited an ability to penetrate the skin of PHN patients and reside locally, in both the skin and underlying tissue, at relatively high concentrations.
- Application of TV-45070 to the human torso in Phase 1 and Phase 2 clinical trials to date resulted in low systemic exposure of TV-45070, which may reduce systemic adverse events.
- Central nervous system, or CNS, side effects were not observed in the topical PHN trial due to low plasma levels, which we believe is a benefit given evidence that PHN patients have shown poor compliance with products that trigger common CNS side effects.
- Topical TV-45070 in the PHN Phase 2 proof-of-concept trial reduced the incidence of itch compared to placebo.
- Lidocaine, a weak sodium channel blocker, provides relief of PHN pain and is approved and widely used for this indication.

The Phase 2b trial is a randomized, double-blind, placebo controlled, multi-site study to evaluate the efficacy and safety of TV-45070 in patients with PHN. The study includes three treatment groups that receive doses of 4% or 8% of TV-45070 or placebo, dosed twice daily. Approximately 330 patients will be enrolled in the study. Patients will be stratified into treatment groups based on their R1150W status, a genetic pain biomarker believed to be related to pain susceptibility. The primary endpoint of this study is the change from baseline to week 4 in the numeric rating scale, or NRS, scores. Secondary endpoints include additional pain measurement scores at specified daily time points, the percentage of patients with greater than 30% and greater than 50% improvement in pain scores, quality of life measurements and adverse events measurements. The first patient was enrolled in April 2015, and results are expected in the second half of 2016.

About Post-Herpetic Neuralgia

PHN is a painful complication of Herpes zoster infection, occurring particularly in patients above the age of 50. Herpes zoster, otherwise known as shingles, generally manifests as a painful skin rash with blisters in a limited area on one side of the body. Pain can occur both before and during the rash, and can also persist after the infection has resolved. PHN is defined as pain that persists for 120 days or longer after the onset of rash. It is estimated that the annual incidence of Herpes zoster is between 230 and 630 cases per 100,000 people, with PHN occurring in approximately 20% of cases, resulting in approximately 200,000 PHN patients in the U.S.

Like other forms of neuropathic pain, there is a need for improved treatments for PHN. The current leading drugs used to treat PHN suffer from low efficacy for many patients and common dose limiting side effects. It has been reported that 30% to 50% of PHN patients achieve a 30% to 50% improvement in their pain with these agents. Currently prescribed treatments include Pfizer's Lyrica, and generic forms of gabapentin, both of which target the same mechanism. Common side effects for these drugs include sleepiness, dizziness, blurred vision, edema and weight gain.

GDC-0276, GDC-0310, and Other Selective Inhibitors of Nav1.7 for the Treatment of Pain

In December 2011, we entered into a collaborative research and license agreement with Genentech and its affiliate, F. Hoffman-La Roche Ltd, or Roche, to discover and develop selective oral inhibitors of Nav1.7 for the treatment of pain. For a more detailed description of the terms of this agreement with Genentech, see “—Strategic Alliances” below. Based on our discovery of Nav1.7 deficiency underlying CIP, we believe that Nav1.7 is a highly-validated target for the treatment of pain. Our Genentech collaboration is focused on discovering and developing selective oral Nav1.7 inhibitors, which is in contrast to our Teva partnership that is focused on developing a topical drug that targets a number of different sodium channels, including Nav1.7.

Genentech is currently conducting Phase 1 clinical trials for GDC-0276 and GDC-0310, which are both oral, selective Nav1.7 small-molecule inhibitors being developed for the potential treatment of pain. Both Phase 1 clinical trials are ongoing, and pending a full assessment of the results, Genentech intends to initiate a Phase 2 trial in 2016.

To study the effects of targeting Nav1.7 for the treatment of pain, we developed an animal model of inherited EM, or IEM, by expressing human Nav1.7 carrying a known IEM mutation in mice. These mice demonstrate a greater sensitivity to pain. As shown in the figure below, with a single dose of GDC-0276, these mice have fewer pain events demonstrating the ability of GDC-0276 to inhibit Nav1.7 in vivo.

Chronic pain conditions, such as severe cancer pain and neuropathic pain, are generally recognized as unmet medical needs providing potential commercial opportunities for a new oral pain drug. Currently available pain drugs often have either a lack of meaningful pain relief or dose limiting side effects for many patients. An orally administered selective Nav1.7 inhibitor could present a novel mechanism for the treatment of moderate to severe pain as a single agent or in combination with existing analgesics that work through different mechanisms. This mechanism contrasts with our non-selective sodium channel inhibition approach taken with TV-45070. We believe that the selective inhibition of Nav1.7 may lower the potential for dose-limiting central nervous system side-effects and allow for an improved side-effect profile for oral administration of such an inhibitor, which could potentially allow for the treatment of pain that has a central or deep tissue component, including cancer pain and neuropathic pain.

We formed a second collaboration with Genentech in March 2014 for pain genetics, where we intend to focus on rare phenotypes where individuals have an inability to perceive pain or where individuals have non-precipitated spontaneous severe pain. For a more detailed description of the terms of this second agreement with Genentech, see “—Strategic Alliances” below. We believe these phenotypes may unlock new key molecular regulators of pain signaling in humans, which we will seek to validate as targets for new pain drugs. For example, we are analyzing CIP families that are not explained by Nav1.7 deficiency as well as families with conditions associated with severe pain phenotypes such as paroxysmal extreme pain disorder, or PEPD, inherited EM and cluster headache.

Selective Small-Molecule Inhibitors of Targets for the Treatment of Cardiovascular Disease

We entered into a collaborative research and option agreement with Merck in June 2009 to discover novel targets and compounds for the treatment of cardiovascular disease using our Extreme Genetics discovery platform. For a more detailed description of the terms of our agreement with Merck, see “—Strategic Alliances” below. In 2012, Merck exercised its option to obtain an exclusive license to a target for cardiovascular disease and compound inhibitors that were discovered during the research collaboration. The target, when inhibited, is predicted to provide a beneficial lipid profile with the goal of protecting from cardiovascular disease.

Our Proprietary Product Candidates

XEN801 for the Treatment of Acne

XEN801 is a selective, small molecule inhibitor of SCD1 being developed for the treatment of moderate to severe acne. SCD1 is an enzyme involved in lipid synthesis that is expressed in sebaceous glands in the skin. Mice deficient in SCD1 have a marked phenotype of sebaceous gland atrophy suggesting that inhibition of SCD1 activity in the skin may provide a novel treatment option for disorders of enlarged or overactive sebaceous glands, including acne. Published literature studying animals deficient in skin SCD1 have shown that these animals have lower levels of certain lipids produced by sebaceous glands, increased levels of retinoic acid, and increased levels of retinoic acid induced proteins including greatly elevated expression of Lipocalin-2, or LCN2, a gene which transcribes neutrophil gelatinase-associated lipocalin, or NGAL. NGAL has been shown to mediate sebaceous gland cell death and may also have antibacterial properties. LCN2 is also highly upregulated and NGAL levels increased in a human sebaceous gland cell line treated with a SCD1 inhibitor. Published reports on isotretinoin, an approved acne treatment, also support the theory that isotretinoin’s therapeutic effects are achieved in part through increasing levels of NGAL.

We have discovered and developed novel small-molecule SCD1 inhibitors to which we have sole rights. In multiple animal models, we have shown that our SCD1 inhibitors can reduce the size and number of sebaceous glands. XEN801 has demonstrated good properties for topical administration including formulation in a light gel and adequate skin penetration in multiple animal species.

In preclinical mouse models, XEN801 applied topically showed reduction in the size of sebaceous glands in the underlying skin in a time and dose dependent manner.

In these preclinical mouse efficacy studies, at the vehicle treated sites, numerous normally sized lipid loaded sebaceous glands are visible whereas only very small sebaceous glands with hardly any visible lipids are present at the XEN801 treated sites. These reductions are visible after two days of twice-daily treatment and reached statistical significance after seven days (data presented in the above figure), reverting to normal levels once the treatment is stopped. Skin areas distant from the XEN801 treated sites exhibit no changes in sebaceous glands which is consistent with the observed low plasma concentrations of XEN801 and the high local concentrations found in the skin at the treated sites.

We believe these properties support the local treatment of acne and other dermatological disorders with topical XEN801 by decreasing the size of the sebaceous glands, while leaving the skin in other areas unaffected and not exposed unnecessarily to high drug concentrations.

Clinical Development of XEN801

In September 2015, we initiated a Phase 1 clinical trial of XEN801, which was completed by the end of the year. In the Phase 1 study, XEN801 was found to be safe and generally well tolerated. In total, 48 healthy volunteers were dosed for either a 14-day or 21-day treatment period. A number of different dose volumes of the 1% XEN801 drug product were evaluated in the Phase 1 clinical trial with dosing on the back and face of healthy volunteers to determine the maximum tolerated dose. As expected, the most common side effects were localized, generally mild skin reactions. No serious adverse events were observed. Maximal plasma concentrations of XEN801 were low, whereas the median skin concentration of XEN801 was above the drug concentration predicted for efficacy for all dose volumes evaluated. A Phase 2 dose was selected based on favorable tolerability and skin drug concentrations.

In February 2016, we initiated a Phase 2 clinical trial in patients with moderate to severe acne. The Phase 2 clinical trial is a randomized, double-blind, multi-center, vehicle-controlled, parallel-group study to determine the safety, tolerability, efficacy and systemic exposure of XEN801 in approximately 150 patients with moderate to severe facial acne. Patients will apply XEN801 (or vehicle placebo) topically to their face for 12-weeks with a 4-week follow up. The primary efficacy endpoint is the percent change in total (inflammatory and non-inflammatory) lesion count from baseline to week 12. Secondary endpoints include the percent change in inflammatory and/or non-inflammatory lesions at different time points throughout the 12 week study as well as a number of Investigator's Global Assessment measures. We anticipate topline results in the fourth quarter of 2016.

About Acne

Acne is a multifactorial disease of the pilosebaceous unit, which are skin structures consisting of a hair follicle and its associated sebaceous gland. Increased levels of androgens, such as testosterone, which occurs during puberty cause an enlargement of the sebaceous gland that increases the amount of sebum, a naturally occurring oil, production. Acne develops as a result of blockages in the hair follicles due to the sebaceous glands becoming clogged with excess sebum and dead skin cells. Under these conditions, the bacteria *Propionibacterium acnes* can multiply and cause the noticeable inflammatory lesions. We believe that topically applied SCD1 inhibitors will treat acne at its root cause by reducing the underlying sebaceous gland enlargement and reducing sebum production. With its association with the onset of puberty, acne prevalence peaks in late adolescence and is estimated to affect 40 to 50 million people in the U.S, of which there are approximately 11 million and 1.2 million individuals with moderate and severe acne, respectively.

Milder forms of acne are normally treated with over the counter products such as those containing benzoyl peroxide whereas moderate and severe forms of acne are often treated with the prescription drug isotretinoin. Isotretinoin is effective with the majority of patients reporting an improvement and approximately 50% of patients reporting remission of their acne. Scientific studies have shown that isotretinoin can cause apoptosis, a form of cell death, in sebaceous glands thereby reducing sebum production. Isotretinoin treatment has been associated with relatively common side effects including thin and dry skin, hair loss, severe acne flares, blood lipid and liver enzyme elevations. However, the most significant adverse event of isotretinoin is birth defects if taken by women during pregnancy or even a short time before conception due to its teratogenic potential. In 2005, the FDA approved a risk management plan for isotretinoin called iPLEDGE. Under this program, general practitioners are prohibited to prescribe isotretinoin and patients are referred to dermatologists registered and activated in the iPLEDGE program. In addition, patients are also required to register and qualify for the iPLEDGE program. Isotretinoin can only be dispensed for a 30-day supply (no refills) by a registered pharmacy. We believe that a safer alternative drug (without an onerous risk mitigation plan) that potentially reduces sebum production may be a significant treatment option for moderate to severe acne.

Selective Small-Molecule Sodium Channel Inhibitors for the Treatment of Severe Childhood Epilepsy Disorders

We are developing selective inhibitors of the voltage-gated sodium channel Nav1.6 as a treatment for severe childhood epilepsy disorders, such as the orphan disease DS. We have developed considerable expertise in voltage-gated sodium channel biology and have accumulated significant experience in the development of selective sodium channel inhibitors. We are leveraging this expertise and chemistry know-how for the development of selective inhibitors of Nav1.6 for the treatment of severe childhood epilepsy disorders, such as DS.

With our collaborators from McGill University, we identified the genetic link between rare human epilepsy and mutations in the Nav1.1 gene. For example, it is now estimated that approximately 80% of DS cases are believed to be due to mutations in one copy of the Nav1.1 voltage-gated sodium channel that cause a partial loss of Nav1.1 function. Nav1.1 plays a critical role in the normal functioning of inhibitory pathways in the brain. The lack of fully functioning Nav1.1 and inhibitory pathways allows the brain excitatory pathways to be unopposed resulting in the severe seizures of DS. The brain excitatory pathways are preferentially mediated by the voltage-gated sodium channel Nav1.6 and therefore if we are able to selectively inhibit Nav1.6 with a small-molecule compound, we expect to taper this neuronal excitation and thereby treat rare forms of severe childhood epilepsy, such as DS. To further support inhibiting Nav1.6 as a potential therapeutic approach to treat DS and other forms of rare epilepsy, published data has shown that seizures and premature death observed in a DS mouse model can be corrected when these animals are bred with a Nav1.6 knockout mouse. While DS is one of the most resistant epilepsies to treatment, there are other intractable childhood seizures that have been associated with genetically-linked partial loss of function of Nav1.1 or gain of function of Nav1.6, which may benefit from a selective inhibitor of Nav1.6, including intractable childhood epilepsy with generalized tonic-clonic seizures and sporadic infantile epileptic encephalopathy.

Based on our experience and know-how in developing selective ion channel inhibitors, we have identified potent, selective Nav1.6 inhibitors and have demonstrated efficacy for seizures in an animal model with such an inhibitor. We expect to identify a development candidate in 2016 and file an IND application in the first half of 2017. Given the orphan nature of severe childhood epilepsies, including DS, we believe that these indications may represent attractive opportunities for us to independently develop and commercialize product candidates.

New Pipeline Opportunities

In addition to our study of rare human disorders of extreme pain or the absence of pain, we are also studying other rare disorders with extreme phenotypes that we believe could yield new drug targets in disorders where high medical need exists. Given our expertise in ion channel drug discovery, we are also focusing our discovery efforts on the identification of ion channel targets where we believe novel selective inhibitors might represent significant therapeutic advances with a focus on orphan indications.

Strategic Alliances

Agreement with uniQure for Glybera

Effective August 2000, we entered into a sublicense and research agreement with uniQure (formerly Amsterdam Molecular Therapeutics) pursuant to which we granted to uniQure an exclusive, worldwide sublicense under certain intellectual property controlled by us to develop and commercialize technology and compounds related to the variant of LPL, called LPL^{S447X}. Together with collaborators from UBC, we demonstrated that the LPL^{S447X} variant resulted in increased LPL enzyme activity leading to reduced triglyceride levels in humans. Under our sublicense and research agreement with uniQure, we collaborated with uniQure and UBC on preclinical activities, and thereafter uniQure developed an LPL gene therapy product, Glybera, which contains the LPL^{S447X} variant. Glybera was approved in the EU in October 2012 to treat LPLD in patients with severe or multiple pancreatic attacks despite dietary fat restrictions. uniQure conducted the clinical trials and is responsible for the commercialization of Glybera.

Under the terms of the agreement, we are eligible to receive mid single-digit royalties on net sales of the licensed products, for sales made by uniQure and its affiliates. The royalty rates are reduced to a low single-digit for sales made by uniQure and its affiliates in countries where a licensed technology or a licensed product is not covered by a valid patent claim. Such royalties are payable until the expiration of the last licensed patent from UBC. With respect to uniQure's sublicense to Chiesi, we are eligible to receive a percentage in the low twenties of all non-royalty compensation relating to the licensed technology or products that uniQure receives from Chiesi (for example upfront

payments and milestone payments), a percentage in the low twenties of any royalties that uniQure receives from Chiesi based on sales of technology or products covered by the licensed patents, plus a mid single-digit percentage of certain further royalties that uniQure receives from Chiesi based on sales of our licensed technology or products after the expiration of all licensed patents covering the licensed technology or products during the period expiring ten years after the date of the first sale by or on behalf of Chiesi. If uniQure grants a sublicense to a third party other than to Chiesi, then we are eligible to receive a percentage in the low twenties of all non-royalty compensation relating to the licensed technology or products that uniQure receives from such sublicensee (for example upfront payments and milestone payments), plus a percentage in the low twenties of any royalties that uniQure receives from such sublicensee based on sales of technology or products covered by the licensed patents. Although commercial sales of Glybera commenced in the fourth quarter of 2015, we do not expect to receive significant revenue in the near-term from these sales. Furthermore, royalties we are eligible to receive pursuant to our agreement with uniQure, including royalties related to sales made by Chiesi, are subject to customary royalty stacking deductions in the event that uniQure, or any of its sublicensees, have to license other technologies in order to commercialize Glybera.

We are eligible to receive certain additional milestone payments of less than CAD\$1.0 million for Glybera and for each subsequent product, if any, developed pursuant to the agreement with uniQure. We, in turn, have certain payment obligations to our licensor, UBC, based on amounts received from uniQure or otherwise based on the exploitation of the licensed intellectual property.

Our sublicense agreement with uniQure expires on the date of the expiration of the UBC license agreement. Either party may terminate the agreement in the event of the other party's default under the agreement that remains uncured for 20 days after receipt of notice from the non-breaching party.

Agreement with UBC

Effective August 2000, we entered into a license agreement with UBC pursuant to which UBC granted to us an exclusive, worldwide license under UBC's interest in certain intellectual property controlled by UBC to develop and commercialize technology and compounds in the field of gene therapy, including products that related to the variant of LPL, called LPL^{S447X}.

Under the terms of the agreement, UBC is eligible to receive certain pre-commercial milestone payments. UBC is also eligible to receive a mid single-digit percentage of certain compensation that we receive based on sublicenses granted by us to a third party relating to the licensed technology or products, including in connection with our sublicensing agreement with uniQure for LPL^{S447X}.

Through December 31, 2015, we have paid to UBC upfront fees and milestone payments totaling CAD\$271,000 and are obligated to pay a certain additional milestone payment of approximately CAD\$200,000 for Glybera and further milestone payments of CAD\$322,500 for each subsequent product, if any, developed pursuant to our sublicensing agreement with uniQure.

Our license agreement with UBC expires on the date of the expiration of the last patent granted under such license. In the event that our sublicense with uniQure is terminated, we may terminate the agreement with 30 days advance notice to UBC. Either party may terminate the agreement in the event of the other party's default under the agreement that remains uncured for 30 days after receipt of notice from the non-breaching party, and UBC may terminate without such cure period in the event of certain types of breach by us.

Agreement with Teva for TV-45070

In December 2012, we entered into a collaborative development and license agreement with Teva, through its subsidiary, Ivax, pursuant to which we granted Teva an exclusive worldwide license to develop and commercialize certain products, including TV-45070. Under the terms of the agreement, Teva paid us an upfront fee of \$41.0 million. We are collaborating with Teva to further develop TV-45070, and Teva is funding all development costs with respect to the licensed products. In addition, we are eligible to receive potential milestone payments totaling up to \$335.0 million, comprised of a \$20.0 million clinical milestone payment, up to \$285.0 million in regulatory milestone payments, and a \$30.0 million sales-based milestone payment. If TV-45070 is approved, we are also eligible to receive royalties in the low teens to the low twenties on net sales of the licensed products for the timeframe ending upon the latest of (a) expiration of the last valid claim of a licensed patent covering the product, (b) the date on which such product loses market exclusivity and (c) the 10th anniversary of first commercial sale, in each case on a country-by-country basis.

We have an option to a 20% to 30% co-promotion interest for products incorporating TV-45070 in the U.S. Our exercise of this option is subject to meeting objective financial conditions, staffing requirements and compliance standards to be determined in Teva's reasonable discretion in accordance with standard industry practice. Our

co-promotion option is exercisable upon the filing of the first new drug application, or NDA, for a TV-45070 product with the FDA and we will be obligated to pay an opt-in fee to Teva, which is calculated by multiplying our co-promotion interest (as a percentage) by the amount of certain milestones paid or payable by Teva, to which is added certain past and future development costs incurred by Teva with respect to the product for the U.S. Our co-promotion interest is in the 20% to 30% range, and equals our percentage share of detailing activities and co-promotion expenses. Such opt-in fee is payable as a reduction to the milestone payments or our share of operating profits that Teva would otherwise owe to us or a combination of the two. If we exercise this option, upon paying an opt-in fee to Teva, we will be eligible to receive, in lieu of royalties with respect to such product sales in the U.S., a percentage share (equal to our co-promotion interest) of operating profits from such product sales in the U.S.

Our agreement with Teva expires on the date of the expiration of all payment obligations to us under the agreement. Teva may terminate the agreement with 60 days advanced written notice to us after at least three Phase 2 (or later stage) clinical trials have been completed or in the event that safety or efficacy issues arise in the development of the licensed products. Either party may terminate the agreement in the event of the other party's material breach which remains uncured for 90 business days. In certain termination circumstances, we would receive licenses to Teva intellectual property relating to TV-45070 clinical development and regulatory filings. If patents within such Teva intellectual property cover the TV-45070 product, then Teva is eligible to receive royalties from us based on a percentage of net product sales, within the mid single-digit range. Pursuant to the terms of our agreement with Teva, an affiliate of Teva purchased 1,111,111 common shares in our initial public offering, based upon the initial public offering price of \$9.00 per share.

Agreements with Genentech for GDC-0276, GDC-0310, and Selective Inhibitors of Nav1.7 and Pain Genetics

In December 2011, we entered into a collaborative research and license agreement with Genentech and its affiliate, Roche, to discover and develop small and large molecules that selectively inhibit the Nav1.7 sodium channel and companion diagnostics for the potential treatment of pain. Pursuant to this agreement, we granted Genentech a worldwide exclusive license to develop and commercialize compounds directed to Nav1.7 and products incorporating such compounds for all uses. We also granted Genentech a worldwide non-exclusive license to diagnostic products for the purpose of developing or commercializing such compounds.

Under the terms of the agreement, Genentech paid us an upfront fee of \$10.0 million, a \$5.0 million milestone payment for the selection of GDC-0276 for development and an \$8.0 million milestone payment upon the approval by Health Canada of the clinical trial application, or CTA, for GDC-0276. Genentech is providing funding to us for certain of our full-time equivalents, or FTEs, performing the research collaboration plan. In addition, we are eligible to receive pre-commercial and commercial milestone payments with respect to the licensed products totaling up to an additional \$613.0 million, comprised of up to \$45.5 million in preclinical and clinical milestone payments, up to \$387.5 million in regulatory milestone payments, and up to \$180.0 million in sales-based milestone payments for multiple products and indications. In addition, we are eligible to receive royalties based on net sales of the licensed products, which range from a mid single-digit percentage to ten percent for small-molecule inhibitors for the timeframe that such products are covered by the licensed patents and a low single-digit percentage thereafter until the date that is ten years after first commercial sale on a country-by-country basis, plus a low single-digit percentage for large molecule inhibitors of Nav1.7 for a period of ten years from first commercial sale on a country-by-country basis.

Our agreement with Genentech expires on the date of the expiration of all payment obligations to us under the agreement. Genentech may terminate the agreement with three months advance notice anytime on or after the third anniversary of the effective date of the agreement, and each party may terminate the agreement in the event of a material breach by the other party that remains uncured after 90 days. In the event that Genentech terminates the agreement due to our breach, Genentech retains its licenses and its payment obligations to us are reduced. In the event that we terminate the agreement due to Genentech's breach, the rights and licenses granted to Genentech revert back to us, subject to certain rights to make and use certain large-molecule product candidates that are retained by Genentech, and Genentech is obligated to assign certain regulatory approvals and grant certain licenses to us to enable us to develop and commercialize certain terminated products outside of the collaboration.

In May 2015, we amended the collaborative research and license agreement to leverage the work performed in our ongoing Nav1.7 pain collaboration with Genentech for use in our research and development program directed towards modulators of Nav1.6 for use in the field of treating epilepsy, including DS. Pursuant to the amendment, we obtained a worldwide, non-exclusive, revocable license under intellectual property previously licensed by us to Genentech and intellectual property developed under the Nav1.7 collaboration that is necessary or useful to make and use certain Nav1.6 modulators for use in the field, excluding commercialization. We obtained a right of first negotiation for a

certain period of time to obtain a worldwide, exclusive license under the intellectual property licensed to us to commercialize certain Nav1.6 modulators to treat any disease in the field. We also granted Genentech a right of first negotiation to enter into a drug research and development collaboration with us for our Nav1.6 program. Genentech can terminate the license upon 90 days' notice after the third anniversary of the amendment or at any time upon our uncured material breach.

Pursuant to the amendment, we granted Genentech a worldwide exclusive license under intellectual property developed under our Nav1.6 program. The license permits Genentech to develop and commercialize compounds identified or first made in our Nav1.6 program for all uses outside the field of epilepsy and to develop and commercialize compounds (other than certain compounds identified or first made in our Nav1.6 program) for all uses. If Genentech reaches certain development milestones for and/or sells certain compounds identified or first made in our Nav1.6 program that are covered by a patent licensed to Genentech under the amendment, products containing such compound would be included in the products subject to the royalty and milestone obligations payable to us under the original agreement. The collaborative research and license agreement was amended again in December 2015 to extend the term of the research program.

In March 2014, we entered into an additional agreement with Genentech for pain genetics, where we intend to use our Extreme Genetics discovery platform to focus on identifying genetic targets associated with rare phenotypes where individuals have an inability to perceive pain or where individuals have non-precipitated spontaneous severe pain. Pursuant to the terms of this agreement, any intellectual property arising out of the collaboration will be jointly owned by us and Genentech. We have also granted Genentech a time-limited, exclusive right of first negotiation on a target-by-target basis to form joint drug discovery collaborations. Under the terms of this agreement, Genentech paid us an upfront payment of \$1.5 million, a \$0.25 million milestone payment related to the identification of a novel pain target in September 2015, and we are eligible for an additional \$1.75 million in milestone payments. The agreement terminates upon the expiration of Genentech's time-limited, exclusive right of first negotiation which shall be exercisable for two years. Genentech may terminate the agreement with three months advance notice anytime on or after the 12 month anniversary of the effective date of the agreement, and each party may terminate the agreement in the event of a material breach by the other party that remains uncured for 90 days. Furthermore, pursuant to the terms of a common share put agreement, an affiliate of Genentech, Roche Finance Ltd., invested approximately \$4.5 million in a private placement concurrent with our initial public offering at the same price per share as the initial public offering.

Agreement with Merck for Cardiovascular Disease

In June 2009, we entered into an exclusive collaborative research and option agreement with Merck, pursuant to which the parties conducted a research program to discover and develop novel small-molecule candidates for the potential treatment of cardiovascular disease. Merck provided payments to us for our FTEs who performed our activities pursuant to the research program conducted under the Merck agreement. The Merck collaborative research program ended in December 2012.

Under the terms of the agreement, Merck had the option to obtain an exclusive license under certain intellectual property controlled by us to develop and commercialize compounds and products directed to targets in the research program, which has now expired. In June 2012, Merck exercised its option and paid us \$2.0 million to obtain such a worldwide exclusive license to develop and commercialize compound inhibitors of a target that was identified using our Extreme Genetics discovery platform. Through December 31, 2015, we have received milestone payments and an option fee totaling \$9.0 million, and we are eligible for further research, development and regulatory milestone payments of up to \$64.0 million, comprised of \$21.0 million in preclinical and clinical milestone payments and up to \$43.0 million in regulatory milestone payments for products directed to the licensed target, as well as royalties from the mid to high single-digit range in countries where such products are covered by a valid composition or method of use claim of a Xenon or Merck patent or, if not covered by such claims, royalties in the mid single-digit range for ten years after first commercial sale of such products.

We have an option to co-fund the Phase 1 and first Phase 2 clinical trials of product candidates licensed by Merck by paying Merck 50% of such development costs. Such co-funding option is available at the IND-filing stage for the applicable product candidate. If we exercise our co-funding option then the maximum eligible milestone amounts due to us increase to \$86.5 million and the royalties increase to the high single-digit to the sub-teen double-digit range.

Our agreement with Merck expires on the date of the expiration of all royalty payment obligations to us under the agreement. Merck has the right to terminate the agreement upon providing certain notices to us. Each party may terminate the agreement in the event of a material breach by the other party that remains uncured for 90 days after notice of such breach. In the event that Merck terminates the agreement due to our breach, the licenses granted to Merck survive and becomes fully paid up. In the event that we terminate the agreement due to Merck's breach, the licenses granted to Merck terminate.

Intellectual Property

As part of our business strategy, we generally file patent applications disclosing and claiming the drug targets and their novel uses that we identified with the use of our Extreme Genetics discovery platform, novel compositions that modulate such targets, methods of making and using such compositions and various therapeutic formulations of such compositions that cover our product candidates. In some cases, we also file claims on screening assays as well as compositions and methods for use in diagnosing certain diseases. We generally file applications in the U.S., Canada, the EU and other commercially significant foreign jurisdictions. We also rely on trade secrets, internal know-how, technological innovations and agreements with third parties to develop, maintain and protect our competitive position. Our ability to be competitive will depend on the success of this strategy.

As of December 31, 2015, we owned, co-owned or licensed 56 issued or allowed U.S. patents and approximately 20 pending U.S. patent applications, including provisional and non-provisional filings. We also owned, co-owned or licensed an additional 639 pending and granted counterpart applications worldwide, including 161 country-specific validations of 11 European patents.

We have in-licensed from UBC patent applications and patents related to Glybera, and methods of making and using Glybera. These include European Patent No. 1,200,117, Japanese Patent No. 5,095,894, Canadian Patent No. 2,370,081 and the allowed U.S. Patent Application No. 14/324,151. European Patent No. 1,200,117, Japanese Patent No. 5,095,894 and Canadian Patent No. 2,370,081, are expected to expire in June 2020 (absent any extensions of term); U.S. Patent Application No. 14/324,151, when issued, is expected to expire in June 2020 (absent any extensions of term). In addition, U.S. Patent No. 6,814,962 has claims directed to the use of various recombinant viruses containing LPL coding sequences to treat various pathologies and is expected to expire in November 2020 (absent any extensions of term).

As of December 31, 2015, we owned eight issued U.S. patents and seven pending U.S. patent applications related to TV-45070, and methods of making and using this and certain related compounds. The issued patents are expected to expire between 2026 and 2030 (absent any extensions of term). In addition, we have 67 foreign issued patents (exclusive of European patent national validation) and have filed 145 corresponding applications in various foreign jurisdictions relating to TV-45070 and certain related compounds.

As of December 31, 2015, we, together with Genentech, co-owned two issued U.S. patents, two pending U.S. patent applications and 30 pending counterpart patent applications worldwide relating to GDC-0276 and methods of making and using this and certain related compounds. The issued patents, as well as patents issuing from these applications are expected to expire in 2033 (absent any extensions of term). We also co-owned with Genentech one pending U.S. patent application, one pending PCT international application, and three corresponding applications in various foreign jurisdictions relating to GDC-0310 and certain related compounds. Any patents issuing from these applications are expected to expire between 2034 and 2035 (absent any extensions of term).

As of December 31, 2015, we owned or co-owned four issued U.S. patents related to XEN801, and methods of making and using this and certain related compounds. These issued patents are expected to expire between 2024 and 2028 (absent any extensions of term). In addition, we have 27 foreign issued patents (exclusive of European patent national validation) and have filed nine corresponding applications in various foreign jurisdictions relating to XEN801 and certain related compounds.

We may obtain patents on our novel compositions before we obtain marketing approval for product candidates containing such compositions. Because patents are only valid for a limited period, and the life of a particular patent may begin prior to the commercial sale of the related product, the commercial value of any patent is limited. However, in certain circumstances, we may be able to seek patent term extensions for patents in the U.S. and in a number of European countries, compensating in part for delays in obtaining marketing approval, but we cannot be certain we will obtain such extensions.

Further, the existence of issued patents does not guarantee our right to practice the patented technology or commercialize any product candidate covered by such a patent. Third parties may have or obtain rights to other patents that could be used to prevent or attempt to prevent us from commercializing our product candidates. If these other parties are successful in obtaining valid and enforceable patents, and establishing our infringement of those patents, we could be prevented from commercializing our product candidates unless we were able to obtain a license under such patents, which may not be available on commercially reasonable terms or at all.

In the conduct of our business, we may infringe patents or other proprietary rights of third parties. If we do infringe such patents or other proprietary rights, we could be prevented from developing or selling products or from using the processes covered by those patents, could be required to pay substantial damages or could be required to obtain a license from the third party to allow us to use their technology, which may not be available on commercially reasonable terms or at all. If we are not able to obtain a required license or develop alternative technologies, we may be unable to develop or commercialize some or all of our products, and our business could be adversely affected.

Much of our scientific capabilities depend upon the knowledge, experience and skills of key scientific and technical personnel. To protect our rights to our proprietary know-how and technology, we require all our employees, consultants and advisors to enter into confidentiality agreements that require disclosure and assignment to us of ideas, developments, discoveries and inventions made by these employees, consultants and advisors in the course of their service to us.

We may be unable to obtain, maintain and protect the intellectual property rights necessary to conduct our business, and we may be subject to claims that we infringe or otherwise violate the intellectual property rights of others, which could materially harm our business. Although we believe our patents and patent applications provide us with a competitive advantage, the patent positions of biotechnology and pharmaceutical companies can be uncertain and involve complex legal and factual questions. We and our collaborators may not be able to develop patentable product candidates or processes or obtain patents from pending patent applications. Even if patent claims are allowed, the claims may not issue, or in the event of issuance, may not be sufficient to protect the technology owned by or licensed to us or to our collaborators. In certain cases where we have licensed rights to our intellectual property to our collaborators, such collaborators have assumed control of the prosecution and maintenance of the intellectual property portfolio related to such licensed rights. If our collaborators fail to adequately prosecute or maintain any portion of our licensed intellectual property, the competitive advantage and value of our intellectual property portfolio may be reduced. For more information, see “Risk Factors—Risks Related to Our Intellectual Property Rights.”

We own a number of trademarks and intend to develop names for our product candidates and as appropriate seek to secure trademark protection for them, including domain name registration, in relevant jurisdictions.

Competition

The biotechnology and pharmaceutical industries are highly competitive and are characterized by rapidly advancing technologies and a strong emphasis on proprietary products. While we believe that our technology, development experience, scientific knowledge and drug discovery approach provide us with certain advantages, we face potential competition in target discovery and product development from many different approaches and sources, including pharmaceutical and biotechnology companies, academic institutions and governmental agencies and public and private research institutions. Any product candidates or products that we or our collaborators successfully develop and commercialize will compete with existing products and new products that may become available in the future.

With respect to target discovery activities, competitors and other third parties, including academic and clinical researchers, may be able to access rare families and identify targets before we do.

Many of the companies against which we are competing or against which we may compete in the future have significantly greater financial resources and expertise in research and development, manufacturing, preclinical testing, conducting clinical trials, obtaining regulatory approvals and marketing approved products than we do. Mergers and acquisitions in the pharmaceutical and biotechnology industries may result in even more resources being concentrated among a smaller number of our competitors. Smaller or early stage companies may also prove to be significant competitors, particularly through collaboration arrangements with large and established companies.

The key competitive factors affecting the success of all of our product candidates, if approved, are likely to be their efficacy, safety, convenience, price, the effectiveness of alternative products, the level of competition and the availability of coverage, and adequate reimbursement from government and other third party payers.

Our commercial opportunity could be reduced or eliminated if our competitors develop and commercialize products or therapies that are safer, more effective, have fewer or less severe side effects, are more convenient or are less expensive than any products that we may develop. Our competitors also may obtain FDA, European Medicines Agency, or EMA, or other regulatory approval for their products more rapidly than we may obtain approval for ours, which could result in our competitors establishing a strong market position before we are able to enter the market. In addition, our ability to compete may be affected in many cases by insurers or other third party payers seeking to encourage the use of generic products.

Aside from the product marketplace, our competitors also compete with us in recruiting and retaining qualified scientific and management personnel, establishing clinical trial sites, recruiting patients for clinical trials, and by acquiring technologies complementary to, or necessary for, our programs.

Our partnered products and proprietary product candidates that are currently approved or are in clinical development may compete with various therapies and drugs, both in the marketplace and currently under development.

Glybera (alipogene tiparvovec) Competition

There are no approved gene therapies currently on the market for LPLD. The current management of LPLD consists of strict adherence to an extremely low-fat diet, but compliance with such a diet is challenging. Lipid-lowering drugs are generally not effective for treating LPLD. We are not aware of any other drugs or therapies currently in development that treat LPLD by using the LPL sequence containing the LPL^{S447X} genetic variant or otherwise.

TV-45070, GDC-0276, and GDC-0310 Competition

Drug discovery and development for various pain applications is intensely competitive. There are a large number of approved products for neuropathic pain, inflammatory pain and other pain indications. These approved products include capsaicin, celecoxib, lidocaine, narcotic analgesics and pregabalin. We are also aware of clinical-stage development programs at several pharmaceutical and biotechnology companies that are developing Nav1.7 inhibitors or other sodium channel inhibitors for the treatment of pain, including Biogen Inc., Dainippon Sumitomo Co., Ltd., Eli Lilly and Company, Merck, NeuroQuest Inc., and Vertex Pharmaceuticals Inc. Moreover, we are aware of various other product candidates in development that target other mechanisms of action to treat various pain indications, including calcium channel inhibitors, nerve growth factor inhibitors and P2X purinoceptor 3 inhibitors.

XEN801 Competition

If XEN801 were approved for the treatment of acne, we anticipate it would compete with other approved prescription acne products including topical retinoids, oral hormonal therapies, topical and oral antimicrobials, and oral isotretinoin. In addition to approved prescription therapies, there are a wide range of over-the-counter, or OTC, treatments targeted at treating acne. Additionally, there are a number of prescription products that are used “off-label” for the treatment of acne. We are also aware of several products in clinical development that could potentially compete with XEN801, including products in development from Allergan PLC, AOBiome LLC, Braintree Laboratories Inc., Cassiopea SpA, Dermira Inc., Foamix Pharmaceuticals Ltd., Galderma SA, Mimetica Pty Ltd, Novan Therapeutics, Phosphagenics Ltd, Valeant Pharmaceuticals, and XBiotech Inc.

Government Regulation

We are developing both small-molecule and large-molecule product candidates. Our small-molecule product candidates are regulated as drugs by the FDA. The gene therapy product, Glybera, would be regulated by the FDA as a biologic. Within the FDA, the Center for Drug Evaluation and Research, or CDER, regulates drugs and the Center for Biologics Evaluation and Research, or CBER, regulates biological products. Drugs and biological products are subject to regulation under the Federal Food, Drug, and Cosmetic Act, or FD&C Act, and other federal, provincial, state, local and foreign statutes and regulations. Biological products are also subject to regulation under the Public Health Service Act, or PHS Act. Both the FD&C Act and the PHS Act, as applicable, and their corresponding regulations govern, among other things, the testing, manufacturing, safety, efficacy, labeling, packaging, storage, record keeping, distribution, import, export, reporting, advertising and other promotional practices involving drugs and biological products. FDA approval must be obtained before clinical testing of drugs or biological products is initiated, and each clinical study protocol for such product candidates is reviewed by the FDA prior to initiation in the U.S. FDA approval also must be obtained before marketing of drugs and biological products in the U.S. The process of obtaining regulatory approvals and the subsequent compliance with appropriate federal, provincial, state, local and foreign statutes and regulations require the expenditure of substantial time and financial resources and we may not be able to obtain the required regulatory approvals.

Federal and state agencies, congressional committees and foreign governments have expressed interest in further regulating biotechnology. In particular, ethical, social and legal concerns about genetic testing, genetic research and gene therapy could result in additional regulations restricting or prohibiting the processes we may use in discovering and developing our products candidates and in manufacturing and marketing Glybera and any other gene therapy products we or our collaborators may develop. More restrictive regulations or claims that our products are unsafe or pose a hazard could prevent us from commercializing any products. New government requirements may be established that could delay or prevent regulatory approval of our product candidates under development. It is impossible to predict whether legislative changes will be enacted, regulations, policies or guidance changed, or interpretations by agencies or courts changed, or what the impact of such changes, if any, may be.

U.S. Drug Development Process

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

- completion of nonclinical laboratory tests and animal studies according to good laboratory practices, or GLPs, and applicable requirements for the humane use of laboratory animals or other applicable regulations;
- submission to the FDA of an application for an IND, which must become effective before human clinical studies may begin;
- performance of adequate and well-controlled human clinical studies according to the FDA's regulations commonly referred to as good clinical practices, or GCPs, and any additional requirements for the protection of human research subjects and their health information, to establish the safety and efficacy of the proposed product for its intended use;

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- submission to the FDA of an NDA for drug products or a biological license application, or BLA, for biological products for marketing approval that includes substantive evidence of safety, purity, and potency from results of nonclinical testing and clinical studies;
- satisfactory completion of an FDA inspection of the manufacturing facility or facilities where the product is produced to assess compliance with good manufacturing practices, or GMP, to assure that the facilities, methods and controls are adequate to preserve the product's identity, strength, quality and purity;
- potential FDA audit of the nonclinical and clinical study sites that generated the data in support of the NDA or BLA; and
- FDA review and approval of the NDA, or licensure of the BLA.

Before testing any drug or biological product candidate in humans, the product candidate enters the preclinical testing stage. Preclinical tests, also referred to as nonclinical studies, include laboratory evaluations of product chemistry, toxicity and formulation, as well as animal studies to assess the potential safety and activity of the product candidate. The conduct of the preclinical tests must comply with federal regulations and requirements including GLPs.

The clinical study sponsor must submit the results of the preclinical tests, together with manufacturing information, analytical data, any available clinical data or literature and a proposed clinical protocol, to the FDA as part of the IND. Some preclinical testing may continue even after the IND is submitted. The IND automatically becomes effective 30 days after receipt by the FDA, unless the FDA places the clinical study on a clinical hold within that 30-day time period. In such a case, the IND sponsor and the FDA must resolve any outstanding concerns before the clinical study can begin. The FDA may also impose clinical holds on a product candidate at any time before or during clinical studies due to safety concerns or non-compliance. If the FDA imposes a clinical hold, studies may not recommence without FDA authorization and then only under terms authorized by the FDA. Accordingly, we cannot be sure that submission of an IND will result in the FDA allowing clinical studies to begin, or that, once begun, issues will not arise that suspend or terminate such studies.

Clinical studies involve the administration of the drug or biological product candidate to healthy volunteers or patients under the supervision of qualified investigators, generally physicians not employed by or under the study sponsor's control. Clinical studies are conducted under protocols detailing, among other things, the objectives of the clinical study, dosing procedures, subject selection and exclusion criteria, and the parameters to be used to monitor subject safety, including stopping rules that assure a clinical study will be stopped if certain adverse events should occur. Each protocol and any amendments to the protocol must be submitted to the FDA as part of the IND. Clinical studies must be conducted and monitored in accordance with the FDA's regulations comprising the GCP requirements, including the requirement that all research subjects provide informed consent. Further, each clinical study must be reviewed and approved by an independent institutional review board, or IRB, at or servicing each institution at which the clinical study will be conducted. An IRB is charged with protecting the welfare and rights of study participants and considers such items as whether the risks to individuals participating in the clinical studies are minimized and are reasonable in relation to anticipated benefits. The IRB also approves the form and content of the informed consent that must be signed by each clinical study subject or his or her legal representative and must monitor the clinical study until completed.

Human clinical studies are typically conducted in three sequential phases that may overlap or be combined:

- Phase 1. The drug or biological product is initially introduced into healthy human subjects and tested for safety. In the case of some products for severe or life-threatening diseases, especially when the product may be too inherently toxic to ethically administer to healthy volunteers, the initial human testing is often conducted in patients.
- Phase 2. The drug or biological product is evaluated in a limited patient population to identify possible adverse effects and safety risks, to preliminarily evaluate the efficacy of the product for specific targeted diseases and to determine dosage tolerance, optimal dosage and dosing schedule.

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

Post-approval clinical studies, sometimes referred to as Phase 4 clinical studies, may be conducted after initial marketing approval. These clinical studies are used to gain additional experience from the treatment of patients in the intended therapeutic indication, particularly for long-term safety follow-up. The FDA recommends that sponsors observe subjects in studies of gene therapy products for potential gene therapy-related delayed adverse events for a 15-year period, including a minimum of five years of annual examinations followed by ten years of annual queries, either in person or by questionnaire, of study subjects. During all phases of clinical development, regulatory agencies require extensive monitoring and auditing of all clinical activities, clinical data, and clinical study investigators.

Concurrent with clinical studies, companies usually complete additional animal studies and must also develop additional information about the physical characteristics of the drug or biological product as well as finalize a process for manufacturing the product in commercial quantities in accordance with GMP requirements. To help reduce the risk of the introduction of adventitious agents with use of biological products, the PHS Act emphasizes the importance of manufacturing control for products whose attributes cannot be precisely defined. The manufacturing process must be capable of consistently producing quality batches of the product candidate and, among other things, the sponsor must develop methods for testing the identity, strength, quality, potency and purity of the final drug or biological product. Additionally, appropriate packaging must be selected and tested and stability studies must be conducted to demonstrate that the drug or biological product candidate does not undergo unacceptable deterioration over its shelf life.

Human gene therapy products are a new category of therapeutics, and studies of gene therapy products are subject to certain regulatory requirements in addition to those set forth above including certain requirements of the National Institutes of Health.

U.S. Review and Approval Processes

After the completion of clinical studies of a drug or biological product, FDA approval of an NDA or a BLA must be obtained before commercial marketing of the drug or biological product, respectively. The NDA or BLA must include results of product development, laboratory and animal studies, human studies, information on the manufacture and composition of the product, proposed labeling and other relevant information. In addition, under the Pediatric Research Equity Act, or PREA, an NDA or a BLA or supplement to an NDA or a BLA must contain data to assess the safety and effectiveness of the product for the claimed indications in all relevant pediatric subpopulations and to support dosing and administration for each pediatric subpopulation for which the product is safe and effective. The FDA may grant deferrals for submission of data or full or partial waivers. Unless otherwise required by regulation, PREA does not apply to any drug or biological product for an indication for which orphan designation has been granted. The testing and approval processes require substantial time and effort and there can be no assurance that the FDA will accept the NDA or BLA for filing and, even if filed, that any approval will be granted on a timely basis, if at all.

Under the Prescription Drug User Fee Act, or PDUFA, as amended, each NDA or BLA must be accompanied by a substantial user fee. PDUFA also imposes an annual product fee for drugs and biologics and an annual establishment fee on facilities used to manufacture prescription drugs or biologics. Fee waivers or reductions are available in certain circumstances, including a waiver of the application fee for the first application filed by a small business. Additionally, no user fees are assessed on NDAs or BLAs for products designated as orphan drugs, unless the product also includes a non-orphan indication.

Within 60 days following submission of the application, the FDA reviews an NDA or BLA submitted to determine if it is substantially complete before the agency accepts it for filing. The FDA may refuse to file any marketing application that it deems incomplete or not properly reviewable at the time of submission and may request additional information. In this event, the NDA or BLA must be resubmitted with the additional information. The resubmitted application also is subject to review before the FDA accepts it for filing. Once the submission is accepted for filing, the FDA begins an in-depth substantive review of the NDA or BLA. The FDA reviews the application to determine, among other things, whether the proposed product is safe and potent, or effective, for its intended use, and has an acceptable purity profile, and whether the product is being manufactured in accordance with GMP to assure and preserve the product's identity, safety, strength, quality, potency and purity. The FDA may refer applications for novel products or products that present difficult questions of safety or efficacy to an advisory committee, typically a panel that includes clinicians and other experts, for review, evaluation and 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. During the product approval process, the FDA also will determine whether a Risk Evaluation and Mitigation Strategy, or REMS, is necessary to assure the safe use of the product. If the FDA concludes a REMS is needed, the sponsor of the NDA or BLA must submit a proposed REMS; the FDA will not approve the application without a REMS, if required.

Before approving an NDA or a BLA, the FDA will inspect the facilities at which the product is manufactured. The FDA will not approve the product unless it determines that the manufacturing processes and facilities are in compliance with GMP requirements and adequate to assure consistent production of the product within required specifications. Additionally, before approving an NDA or a BLA, the FDA will typically inspect one or more clinical sites to assure that the clinical studies were conducted in compliance with IND study requirements and GCP requirements. To assure GMP and GCP compliance, an applicant must incur significant expenditure of time, money and effort in the areas of training, record keeping, production, and quality control.

Notwithstanding the submission of relevant data and information, the FDA may ultimately decide that the NDA or BLA does not satisfy its regulatory criteria for approval and deny approval. Data obtained from clinical studies are not always conclusive and the FDA may interpret data differently than we interpret the same data. If the agency decides not to approve the marketing application, the FDA will issue a complete response letter that usually describes all of the specific deficiencies in the application identified by the FDA. The deficiencies identified may be minor, for example, requiring labeling changes, or major, for example, requiring additional clinical studies. Additionally, the complete response letter may include recommended actions that the applicant might take to place the application in a condition for approval. If a complete response letter is issued, the applicant may either resubmit the NDA or BLA, addressing all of the deficiencies identified in the letter, or withdraw the application.

If a product receives regulatory approval, the approval may be significantly limited to specific diseases and dosages or the indications for use may otherwise be limited, which could restrict the commercial value of the product. Further, the FDA may require that certain contraindications, warnings or precautions be included in the product labeling. The FDA may impose restrictions and conditions on product distribution, prescribing, or dispensing in the form of a risk management plan, or otherwise limit the scope of any approval. In addition, the FDA may require post-approval clinical studies, sometimes referred to as Phase 4 clinical studies, designed to further assess a product's safety and effectiveness, and testing and surveillance programs to monitor the safety of approved products that have been commercialized.

One of the performance goals agreed to by the FDA under the PDUFA is to complete its review of 90% of standard NDAs and BLAs within ten months from filing and 90% of priority NDAs and BLAs within six months from filing, whereupon a review decision is to be made. The FDA does not always meet its PDUFA goal dates and its review goals are subject to change from time to time. The review process and the PDUFA goal date may be extended by three months if the FDA requests or the application sponsor otherwise provides additional information or clarification regarding information already provided in the submission within the last three months before the PDUFA goal date.

Fast Track Designation

The FDA has various programs, including Fast Track, which are intended to expedite the process for reviewing drugs. Even if a drug qualifies for one or more of these programs, the FDA may later decide that the drug no longer meets the conditions for qualification. Generally, drugs that are eligible for these programs are those for serious or life-threatening conditions, those with the potential to address unmet medical needs, and those that offer meaningful benefits over existing treatments. For example, Fast Track is a process designed to expedite the FDA's review of drugs that treat serious or life-threatening diseases or conditions and fill unmet medical needs. Under the Fast Track process, drugs that offer major advances in treatment or provide a treatment where no adequate therapy exists, may also receive priority review by the FDA, or review within six months of the filing of an NDA compared to a traditional review time of ten months. Although Fast Track and priority review do not affect the standards for approval of a drug, for Fast Track designated drugs, the FDA will also attempt to facilitate early and frequent meetings with a sponsor of a Fast Track designated drug, to expedite such drug's review and development. Although FDA has granted fast track designations to TV-45070 for EM and to Glybera for LPLD, such designations may not result in a faster development or review time, do not increase the odds of approval, and may be rescinded at any time if these drug candidates do not continue to meet the qualifications for these programs.

Orphan Drug Designation

Under the Orphan Drug Act, the FDA may grant orphan designation to a drug or biological product intended to treat a rare disease or condition, which is generally a disease or condition that affects fewer than 200,000 individuals in the U.S., or more than 200,000 individuals in the U.S. and for which there is no reasonable expectation that the cost of developing and making a drug or biological product available in the U.S. for this type of disease or condition will be

recovered from sales of the product. Both Glybera and TV-45070 have received orphan drug designation from the FDA. Orphan product designation must be requested before submitting an NDA or BLA. After the FDA grants orphan product designation, the identity of the therapeutic agent and its potential orphan use are disclosed publicly by the FDA. Orphan product designation does not convey any advantage in or shorten the duration of the regulatory review and approval process.

If a product that has orphan designation subsequently receives the first FDA approval for such drug for the disease or condition for which it has such designation, the product is entitled to orphan product exclusivity, which means that the FDA may not approve any other applications to market the same drug or biological product for the same indication for seven years, except in limited circumstances, such as a showing of clinical superiority to the product with orphan exclusivity. Competitors, however, may receive approval of different products for the indication for which the orphan product has exclusivity or obtain approval for the same product but for a different indication for which the orphan product has exclusivity. Orphan product exclusivity also could block the approval of one of our products for seven years if a competitor obtains approval of the same product as defined by the FDA or if our product candidate is determined to be contained within the competitor's product for the same indication or disease. If a drug or biological product designated as an orphan product receives marketing approval for an indication broader than what is designated, it may not be entitled to orphan product exclusivity. Orphan drug status in the EU has similar, but not identical, benefits, including up to ten years of exclusivity.

Post-Approval Requirements

Maintaining substantial compliance with applicable federal, provincial, state, and local statutes and regulations requires the expenditure of substantial time and financial resources. Rigorous and extensive FDA regulation of drug and biological products continues after approval, particularly with respect to GMP. We will rely, and expect to continue to rely, on third parties for the production of clinical and commercial quantities of any products that we may commercialize. Manufacturers of our products are required to comply with applicable requirements in the GMP regulations, including quality control and quality assurance and maintenance of records and documentation. Other post-approval requirements applicable to drug and biological products, include reporting of GMP deviations that may affect the identity, potency, purity and overall safety of a distributed product, record-keeping requirements, reporting of adverse effects, reporting updated safety and efficacy information, and complying with electronic record and signature requirements. After an NDA or BLA is approved, the product also may be subject to official lot release. As part of the manufacturing process, the manufacturer is required to perform certain tests on each lot of the product before it is released for distribution. If the product is subject to official release by the FDA, the manufacturer submits samples of each lot of product to the FDA together with a release protocol showing a summary of the history of manufacture of the lot and the results of all of the manufacturer's tests performed on the lot. The FDA also may perform certain confirmatory tests on lots of some products before releasing the lots for distribution by the manufacturer. In addition, the FDA conducts laboratory research related to the regulatory standards on the safety, purity, potency, and effectiveness of drug and biological products.

We also must comply with the FDA's advertising and promotion requirements, such as those related to direct-to-consumer advertising, the prohibition on promoting products for uses or in patient populations that are not described in the product's approved labeling (known as "off-label use"), industry-sponsored scientific and educational activities, and promotional activities involving the internet. Discovery of previously unknown problems or the failure to comply with the applicable regulatory requirements may result in restrictions on the marketing of a product or withdrawal of the product from the market as well as possible civil or criminal sanctions. Failure to comply with the applicable U.S. requirements at any time during the product development process, approval process or after approval, may subject an applicant or manufacturer to administrative or judicial civil or criminal sanctions and adverse publicity. FDA sanctions could include refusal to approve pending applications, withdrawal of an approval, clinical hold, warning or untitled letters, product recalls, product seizures, total or partial suspension of production or distribution, injunctions, fines, refusals of government contracts, mandated corrective advertising or communications with doctors, debarment, restitution, disgorgement of profits, or civil or criminal penalties. Any agency or judicial enforcement action could have a material adverse effect on us.

Drug and biological product manufacturers and other entities involved in the manufacture and distribution of approved drug or biological products are required to register their establishments with the FDA and certain state agencies, and

are subject to periodic unannounced inspections by the FDA and certain state agencies for compliance with GMPs and other laws. Accordingly, manufacturers must continue to expend time, money, and effort in the area of production and quality control to maintain GMP compliance. Discovery of problems with a product after approval may result in restrictions on a product, manufacturer, or holder of an approved NDA or BLA, including withdrawal of the product from the market. In addition, changes to the manufacturing process or facility generally require prior FDA approval before being implemented and other types of changes to the approved product, such as adding new indications and additional labeling claims, are also subject to further FDA review and approval.

U.S. Patent Term Restoration and Marketing Exclusivity

Depending upon the timing, duration and specifics of the FDA approval of the use of our product candidates, some of our U.S. patents may be eligible for limited patent term extension under the Drug Price Competition and Patent Term Restoration Act of 1984, commonly referred to as the Hatch-Waxman Amendments. The Hatch-Waxman Amendments permit a patent restoration term of up to five years as compensation for patent term lost during product development and the FDA regulatory review process. However, patent term restoration cannot extend the remaining term of a patent beyond a total of 14 years from the product's approval date. The patent term restoration period is generally one-half the time between the effective date of an IND and the submission date of an NDA or BLA plus the time between the submission date of an NDA or BLA and the approval of that 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.

Under the Hatch-Waxman Amendments, a drug product containing a new chemical entity as its active ingredient is entitled to five years of market exclusivity, and a product for which the sponsor is required to generate new clinical data is entitled to three years of market exclusivity. A drug or biological product can also obtain pediatric market exclusivity in the U.S. Pediatric exclusivity, if granted, adds six months to existing exclusivity periods and patent terms. This six-month exclusivity, which runs from the end of other exclusivity protection or patent term, may be granted based on the voluntary completion of a pediatric study in accordance with an FDA-issued "Written Request" for such a study.

The Biologics Price Competition and Innovation Act of 2009 created an abbreviated approval pathway for biological products shown to be similar to, or interchangeable with, an FDA-licensed reference biological product. Biosimilarity, which requires that there be no clinically meaningful differences between the biological product and the reference product in terms of safety, purity, and potency, can be shown through analytical studies, animal studies, and a clinical study or studies. Interchangeability requires that a product is biosimilar to the reference product and the product must demonstrate that it can be expected to produce the same clinical results as the reference product and, for products administered multiple times, the biologic and the reference biologic may be switched after one has been previously administered without increasing safety risks or risks of diminished efficacy relative to exclusive use of the reference biologic. However, complexities associated with the larger, and often more complex, structure of biological products, as well as the process by which such products are manufactured, pose significant hurdles to implementation that are still being worked out by the FDA.

A reference biologic is granted 12 years of exclusivity from the time of first licensure of the reference product. The first biologic product submitted under the abbreviated approval pathway that is determined to be interchangeable with the reference product has exclusivity against other biologics submitted under the abbreviated approval pathway for the lesser of (i) one year after the first commercial marketing, (ii) 18 months after approval if there is no legal challenge, (iii) 18 months after the resolution in the applicant's favor of a lawsuit challenging the biologics' patents if an application has been submitted, or (iv) 42 months after the application has been approved if a lawsuit is ongoing within the 42-month period.

Additional Regulation

In addition to the foregoing, provincial, state and federal U.S. and Canadian laws regarding environmental protection and hazardous substances affect our business. These and other laws govern our use, handling and disposal of various biological, chemical and radioactive substances used in, and wastes generated by, our operations. If our operations result in contamination of the environment or expose individuals to hazardous substances, we could be liable for damages and governmental fines. We believe that we are in material compliance with applicable environmental laws

and that continued compliance therewith will not have a material adverse effect on our business. We cannot predict, however, how changes in these laws may affect our future operations.

U.S. Foreign Corrupt Practices Act and Canadian Corruption of Foreign Public Officials Act

The U.S. Foreign Corrupt Practices Act and the Canadian Corruption of Foreign Public Officials Act, to which we are subject, prohibit corporations and individuals from engaging in certain activities to obtain or retain business or to influence a person working in an official capacity. It is illegal to pay, offer to pay or authorize the payment of anything of value to any foreign government official, government staff member, political party or political candidate in an attempt to obtain or retain business or to otherwise influence a person working in an official capacity. We can also be held liable for the acts of our third party agents under the Canadian Corruption of Foreign Public Officials Act.

Government Regulation Outside of the U.S.

In addition to regulations in the U.S., we will be subject to a variety of regulations in other jurisdictions governing, among other things, clinical studies and any commercial sales and distribution of our products.

Whether or not we obtain FDA approval for a product, we must obtain the requisite approvals from regulatory authorities in foreign countries prior to the commencement of clinical studies or marketing of the product in those countries. Certain countries outside of the U.S. have a similar process that requires the submission of a clinical study application much like the IND prior to the commencement of human clinical studies. In the EU, for example, a CTA must be submitted to each country's national health authority and an independent ethics committee, much like the FDA and the IRB, respectively. Once the CTA is approved in accordance with a country's requirements, clinical study development may proceed.

The requirements and process governing the conduct of clinical studies, product licensing, coverage, pricing and reimbursement vary from country to country. In all cases, the clinical studies are conducted in accordance with GCP and the applicable regulatory requirements and the ethical principles that have their origin in the Declaration of Helsinki.

To obtain regulatory approval of an investigational drug or biological product under EU regulatory systems, we must submit a marketing authorization application, or MAA. The application used to file the NDA or BLA in the U.S. is similar to that required in the EU, with the exception of, among other things, country-specific document requirements. The EU also provides opportunities for market exclusivity. For example, in the EU, upon receiving marketing authorization, new chemical entities generally receive eight years of data exclusivity and an additional two years of market exclusivity. If granted, data exclusivity prevents regulatory authorities in the EU from referencing the innovator's data to assess a generic application. During the additional two-year period of market exclusivity, a generic marketing authorization can be submitted, and the innovator's data may be referenced, but no generic product can be marketed until the expiration of the market exclusivity. However, there is no guarantee that a product will be considered by the EU's regulatory authorities to be a new chemical entity, and products may not qualify for data exclusivity. Products receiving orphan designation in the EU can receive ten years of market exclusivity, during which time no similar medicinal product for the same indication may be placed on the market. An orphan product can also obtain an additional two years of market exclusivity in the EU for pediatric studies. No extension to any supplementary protection certificate can be granted on the basis of pediatric studies for orphan indications.

The criteria for designating an "orphan medicinal product" in the EU are similar in principle to those in the U.S. Under Article 3 of Regulation (EC) 141/2000, a medicinal product may be designated as orphan if (1) it is intended for the diagnosis, prevention or treatment of a life-threatening or chronically debilitating condition; (2) either (a) such condition affects no more than five in 10,000 persons in the EU when the application is made, or (b) the product, without the benefits derived from orphan status, would not generate sufficient return in the EU to justify investment; and (3) there exists no satisfactory method of diagnosis, prevention or treatment of such condition authorized for marketing in the EU, or if such a method exists, the product will be of significant benefit to those affected by the condition, as defined in Regulation (EC) 847/2000. Orphan medicinal products are eligible for financial incentives such as reduction of fees or fee waivers and are, upon grant of a marketing authorization, entitled to ten years of market exclusivity for the approved therapeutic indication. The application for orphan drug designation must be submitted before the application for marketing authorization. The applicant will receive a fee reduction for the marketing authorization application if the orphan drug designation has been granted, but not if the designation is still pending at the time the marketing authorization is submitted. Orphan drug designation does not convey any advantage in, or shorten the duration of, the regulatory review and approval process. Glybera has received orphan drug designation for the treatment of LPLD in the EU.

The 10-year market exclusivity may be reduced to six years if, at the end of the fifth year, it is established that the product no longer meets the criteria for orphan designation, for example, if the product is sufficiently profitable not to justify maintenance of market exclusivity. Additionally, marketing authorization may be granted to a similar product for the same indication at any time if:

- the second applicant can establish that its product, although similar, is safer, more effective or otherwise clinically superior;
 - the applicant consents to a second orphan medicinal product application; or
- the applicant cannot supply enough orphan medicinal product.

For other countries outside of the EU, such as countries in Eastern Europe, Latin America or Asia, the requirements governing the conduct of clinical studies, product licensing, coverage, pricing and reimbursement vary from country to country. In all cases, again, the clinical studies are conducted in accordance with GCP and the applicable regulatory requirements and the ethical principles that have their origin in the Declaration of Helsinki.

If we fail to comply with applicable foreign regulatory requirements, we may be subject to, among other things, fines, suspension or withdrawal of regulatory approvals, product recalls, seizure of products, operating restrictions and criminal prosecution.

Pharmaceutical Coverage, Pricing and Reimbursement

Significant uncertainty exists as to the coverage and reimbursement status of any product candidates for which we obtain regulatory approval. In the U.S. 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 adequate reimbursement from third-party payers. Third-party payers include government programs such as Medicare or Medicaid, managed care plans, private health insurers, and other organizations. These third-party payers may deny coverage or reimbursement for a product or therapy in whole or in part if they determine that the product or therapy was not medically appropriate or necessary. Third-party payers may attempt to control costs by limiting coverage to specific drug products on an approved list, or formulary, which might not include all of the FDA-approved drug products for a particular indication, and by limiting the amount of reimbursement for particular procedures or drug treatments.

The cost of pharmaceuticals and devices continues to generate substantial governmental and third party payer interest. We expect that the pharmaceutical industry will experience pricing pressures due to the trend toward managed healthcare, the increasing influence of managed care organizations and additional legislative proposals. Third-party payers 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. 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 the FDA approvals. Our product candidates may not be considered medically necessary or cost-effective. A payer'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.

Some third-party payers also require pre-approval of coverage for new or innovative devices or drug therapies before they will reimburse healthcare providers who use such therapies. While we cannot predict whether any proposed cost-containment measures will be adopted or otherwise implemented in the future, these requirements or any announcement or adoption of such proposals could have a material adverse effect on our ability to obtain adequate prices for our product candidates and to operate profitably.

In international markets, reimbursement and healthcare payment systems vary significantly by country, and many countries have instituted price ceilings on specific products and therapies. There can be no assurance that our products will be considered medically reasonable and necessary for a specific indication, that our products will be considered cost-effective by third-party payers, that coverage or an adequate level of reimbursement will be available or that the third-party payers' reimbursement policies will not adversely affect our ability to sell our products profitably.

Healthcare Reform

In the U.S. and foreign jurisdictions, there have been a number of legislative and regulatory changes to the healthcare system that could affect our future results of operations. In particular, there have been and continue to be a number of initiatives at the U.S. federal and state levels that seek to reduce healthcare costs.

In the U.S., the Medicare Prescription Drug, Improvement, and Modernization Act of 2003, or the Medicare Modernization Act, changed the way Medicare covers and pays for pharmaceutical products. The Medicare Modernization Act expanded Medicare coverage for drug purchases by the elderly by establishing Medicare Part D

and introduced a new reimbursement methodology based on average sales prices for physician administered drugs under Medicare Part B. In addition, this legislation provided authority for limiting the number of drugs that will be covered in any therapeutic class under the new Medicare Part D program. Cost reduction initiatives and other provisions of this legislation could decrease the coverage and reimbursement rate that we receive for any of our approved products. While the Medicare Modernization Act applies only to drug benefits for Medicare beneficiaries, private payers often follow Medicare coverage policy and payment limitations in setting their own reimbursement rates. Therefore, any reduction in reimbursement that results from the Medicare Modernization Act may result in a similar reduction in payments from private payers.

In March 2010, the President signed into law the Patient Protection and Affordable Care Act, as amended, or PPACA, a sweeping law intended to broaden access to health insurance, reduce or constrain the growth of healthcare spending, enhance remedies against healthcare fraud and abuse, add new transparency requirements for healthcare and health insurance industries, impose new taxes and fees on pharmaceutical and medical device manufacturers and impose additional health policy reforms. Among other things, PPACA revises the definition of “average manufacturer price” for reporting purposes, which could increase the amount of Medicaid drug rebates to states. Further, the new law imposes a significant annual fee on companies that manufacture or import branded prescription drug products. Substantial new provisions affecting compliance have also been enacted, which may affect our business practices with healthcare practitioners and a significant number of provisions are not yet, or have only recently become, effective. Although it is too early to determine the full effect of PPACA, the new law appears likely to continue the downward pressure on pharmaceutical pricing, especially under the Medicare program, and may also increase our regulatory burdens and operating costs.

In addition, other legislative changes have been proposed and adopted since PPACA was enacted. These new laws may result in reductions in Medicare and other healthcare funding, which could have a material adverse effect on our customers and accordingly, our financial operations.

We expect that PPACA, as well as other healthcare reform measures that have been and may be adopted in the future, may result in more rigorous coverage criteria and in additional downward pressure on the price that we receive for any approved product, and could seriously harm our future revenue. Any reduction in reimbursement from Medicare or other government programs may result in a similar reduction in payments from private payers. The implementation of cost containment measures or other healthcare reforms may prevent us from being able to generate revenue, attain profitability, or commercialize our products.

In addition, different pricing and reimbursement schemes exist in other countries. In the European Community, governments influence the price of pharmaceutical products through their pricing and reimbursement rules and control of national healthcare 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 be marketed only once a reimbursement price has been agreed upon. Some of these countries may require, as condition of obtaining reimbursement or pricing approval, the completion of clinical trials 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 healthcare 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.

Other Healthcare Laws and Compliance Requirements

In the U.S., the research, manufacturing, distribution, sale and promotion of drug products and medical devices are potentially subject to regulation by various federal, provincial, state and local authorities in addition to the FDA, including the Centers for Medicare & Medicaid Services, other divisions of the U.S. Department of Health and Human Services (e.g., the Office of Inspector General), the U.S. Department of Justice, state Attorneys General, and other state and local government agencies. For example, sales, marketing and scientific/educational grant programs must comply with fraud and abuse laws such as the federal Anti-Kickback Statute, as amended, the federal False Claims Act, as amended, and similar state laws. Pricing and rebate programs must comply with the Medicaid Drug Rebate Program requirements of the Omnibus Budget Reconciliation Act of 1990, as amended, and the Veterans Health Care Act of 1992, as amended. If products are made available to authorized users of the Federal Supply Schedule of the General Services Administration, additional laws and requirements apply. All of these activities are also potentially subject to federal and state consumer protection and unfair competition laws.

The federal Anti-Kickback Statute prohibits any person, including a prescription drug manufacturer (or a party acting on its behalf), from knowingly and willfully soliciting, receiving, offering or providing remuneration, directly or indirectly, to induce or reward either the referral of an individual, or the furnishing, recommending, or arranging for a good or service, for which payment may be made under a federal healthcare program such as the Medicare and Medicaid programs. This statute has been interpreted to apply to arrangements between pharmaceutical manufacturers on one hand and prescribers, purchasers, and formulary managers on the other. The term “remuneration” is not defined in the federal Anti-Kickback Statute and has been broadly interpreted to include anything of value, including for example, gifts, discounts, the furnishing of supplies or equipment, credit arrangements, payments of cash, waivers of payments, ownership interests and providing anything at less than its fair market value. Although there are a number of statutory exemptions and regulatory safe harbors protecting certain business arrangements from prosecution, the exemptions and safe harbors are drawn narrowly, and practices that involve remuneration intended to induce prescribing, purchasing or recommending may be subject to scrutiny if they do not qualify for an exemption or safe harbor. Our practices may not in all cases meet all of the criteria for safe harbor protection from federal Anti-Kickback Statute liability. The reach of the Anti-Kickback Statute was broadened by the recently enacted PPACA, which, among other things, amends the intent requirement of the federal Anti-Kickback Statute such that a person or entity no longer needs to have actual knowledge of this statute or specific intent to violate it in order to have committed a violation. In addition, the PPACA provides that 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 False Claims Act (discussed below) or the civil monetary penalties statute, which imposes fines against any person who is determined to have presented or caused to be presented claims to a federal healthcare program that the person knows or should know is for an item or service that was not provided as claimed or is false or fraudulent. Additionally, many states have adopted laws similar to the federal Anti-Kickback Statute, and some of these state prohibitions apply to referral of patients for healthcare items or services reimbursed by any third-party payer, not only the Medicare and Medicaid programs in at least some cases, and do not contain safe harbors.

The federal False Claims Act imposes liability on any person or entity that, among other things, knowingly presents, or causes to be presented, a false or fraudulent claim for payment by a federal healthcare program. The qui tam provisions of the False Claims Act allow a private individual to bring civil actions on behalf of the federal government alleging that the defendant has submitted a false claim to the federal government, and to share in any monetary recovery. In recent years, the number of suits brought by private individuals has increased dramatically. In addition, various states have enacted false claims laws analogous to the False Claims Act. Many of these state laws apply where a claim is submitted to any third-party payer and not merely a federal healthcare program. There are many potential bases for liability under the False Claims Act. Liability arises, primarily, when an entity knowingly submits, or causes another to submit, a false claim for reimbursement to the federal government. The False Claims Act has been used to assert liability on the basis of inadequate care, kickbacks and other improper referrals, improperly reported government pricing metrics such as Best Price or Average Manufacturer Price, improper use of Medicare numbers when detailing the provider of services, improper promotion of off-label uses (i.e., uses not expressly approved by FDA in a drug’s label), and allegations as to misrepresentations with respect to the services rendered. Our future activities relating to the reporting of discount and rebate information and other information affecting federal, provincial, state and third party reimbursement of our products, and the sale and marketing of our products and our service arrangements or data purchases, among other activities, may be subject to scrutiny under these laws. We are unable to predict whether we would be subject to actions under the False Claims Act or a similar state law, or the impact of such actions. However, the cost of defending such claims, as well as any sanctions imposed, could adversely affect our financial performance. Also, the Health Insurance Portability and Accountability Act of 1996, or HIPAA, created several new federal crimes, including healthcare fraud, and false statements relating to healthcare matters. The healthcare fraud statute prohibits knowingly and willfully executing a scheme to defraud any healthcare benefit program, including private third-party payers. The false statements statute prohibits knowingly and willfully falsifying, concealing or covering up a material fact or making any materially false, fictitious or fraudulent statement in connection with the delivery of or payment for healthcare benefits, items or services.

In addition, we may be subject to, or our marketing activities may be limited by, data privacy and security regulation by both the federal government and the states in which we conduct our business. For example, HIPAA and its implementing regulations established uniform federal standards for certain “covered entities” (healthcare providers, health plans and healthcare clearinghouses) governing the conduct of certain electronic healthcare transactions and protecting the security and privacy of protected health information. The American Recovery and Reinvestment Act of 2009, commonly referred to as the economic stimulus package, included expansion of HIPAA’s privacy and security standards called the Health Information Technology for Economic and Clinical Health Act, or HITECH. Among other things, HITECH makes HIPAA’s privacy and security standards directly applicable to “business associates”—independent contractors or agents of covered entities that create, receive, maintain, or transmit protected health information in connection with providing a service for or on behalf of a covered entity. HITECH also increased the civil and criminal penalties that may be imposed against covered entities, business associates and possibly other persons, and gave state attorneys general new authority to file civil actions for damages or injunctions in federal courts to enforce the federal HIPAA laws and seek attorney’s fees and costs associated with pursuing federal civil actions.

There are also an increasing number of state “sunshine” laws that require manufacturers to make reports to states on pricing and marketing information. Several states have enacted legislation requiring pharmaceutical companies to, among other things, establish marketing compliance programs, file periodic reports with the state, make periodic public disclosures on sales, marketing, pricing, clinical trials and other activities, and/or register their sales representatives, as well as to prohibit pharmacies and other healthcare entities from providing certain physician prescribing data to pharmaceutical companies for use in sales and marketing, and to prohibit certain other sales and marketing practices. In addition, beginning in 2013, a similar federal requirement began requiring manufacturers to track and report to the federal government certain payments and other transfers of value made to physicians and other healthcare professionals and teaching hospitals and ownership or investment interests held by physicians and their immediate family members. The federal government discloses the reported information on a publicly available website. These laws may affect our sales, marketing, and other promotional activities by imposing administrative and compliance burdens on us. If we fail to track and report as required by these laws or otherwise comply with these laws, we could be subject to the penalty provisions of the pertinent state and federal authorities.

Because of the breadth of these laws and the narrowness of available statutory and regulatory exemptions, it is possible that some of our business activities could be subject to challenge under one or more of such laws. If our operations are found to be in violation of any of the federal and state laws described above or any other governmental regulations that apply to us, we may be subject to penalties, including criminal and significant civil monetary penalties, damages, fines, imprisonment, exclusion from participation in government healthcare programs, injunctions, recall or seizure of products, total or partial suspension of production, denial or withdrawal of pre-marketing product approvals, private qui tam actions brought by individual whistleblowers in the name of the government or refusal to allow us to enter into supply contracts, including government contracts, 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. To the extent that any of our products are sold in a foreign country, we may be subject to similar foreign laws and regulations, which may include, for instance, applicable post-approval requirements, including safety surveillance, anti-fraud and abuse laws, and implementation of corporate compliance programs and reporting of payments or transfers of value to healthcare professionals.

Environmental Matters

Our operations require the use of hazardous materials (including biological materials) which subject us to a variety of federal, provincial and local environmental and safety laws and regulations. Some of the regulations under the current regulatory structure provide for strict liability, holding a party potentially liable without regard to fault or negligence. We could be held liable for damages and fines as a result of our, or someone else’s, business operations should contamination of the environment or individual exposure to hazardous substances occur. We cannot predict how changes in laws or development of new regulations will affect our business operations or the cost of compliance.

Employees

As of December 31, 2015, we had 83 employees, including 76 full-time employees. Of our employees, 55 were primarily engaged in research and development, and 25 of whom hold a Ph.D. or M.D. (or equivalent) degree. None of our employees are represented by a labor union. We have not experienced any work stoppages, and we consider our relations with our employees to be good.

Research and Development

We have committed, and expect to continue to commit, significant resources to developing new product candidates. We have assembled experienced research and development teams at our Burnaby, British Columbia location with scientific, clinical and regulatory personnel. Our research and development expenses for the years ended

December 31, 2015, 2014, and 2013 were \$15.2 million, \$11.8 million, and \$12.3 million, respectively.

Manufacturing

We currently rely, and expect to continue to rely, on third parties and our collaborators for the manufacture of our product candidates for preclinical and clinical testing, as well as for commercial manufacture if our product candidates receive marketing approval. Accordingly, we have not internally developed any manufacturing facilities or hired related personnel.

To date, we have obtained materials for our product candidates from multiple third-party manufacturers. We believe that all of the materials required for the manufacture of our product candidates can be obtained from more than one source. However, the manufacturing processes for each of our product candidates, which include large and small-molecules, vary and sourcing adequate supplies may be made more difficult depending on the type of product candidate involved. Our small-molecule product candidates generally can be manufactured in reliable and reproducible synthetic processes from readily available starting materials. This chemistry generally is amenable to scale-up and does not require unusual equipment in the manufacturing process.

Corporate Information

We were incorporated in the Province of British Columbia on November 5, 1996 under the predecessor to the Business Corporations Act (British Columbia) under the name “Xenon Bioresearch Inc.” We continued from British Columbia to the federal jurisdiction pursuant to Section 187 of the Canada Business Corporations Act, or the CBCA, on May 17, 2000 and concurrently changed our name to “Xenon Genetics Inc.” We registered as an extra-provincial company in British Columbia on July 10, 2000 and changed our name to “Xenon Pharmaceuticals Inc.” on August 24, 2004. We have no subsidiaries. Our principal executive offices are located at 200 – 3650 Gilmore Way, Burnaby, British Columbia, Canada V5G 4W8, and our telephone number is (604) 484-3300. We are a reporting issuer in British Columbia, Alberta and Ontario, but our shares are not listed on any recognized Canadian stock exchange. Our common shares trade on The NASDAQ Global Market under the symbol “XENE.”

Where You Can Find Additional Information

We make available free of charge through our investor relations website, <http://www.xenon-pharma.com>, our annual reports, quarterly reports, current reports, proxy statements and all amendments to those reports as soon as reasonably practicable after such material is electronically filed or furnished with the SEC. These reports may also be obtained without charge by contacting Investor Relations, Xenon Pharmaceuticals Inc., 200 – 3650 Gilmore Way, Burnaby, British Columbia, Canada V5G 4W8, e-mail: investors@xenon-pharma.com. Our Internet website and the information contained therein or incorporated therein are not intended to be incorporated into this Annual Report on Form 10-K. In addition, the public may read and copy any materials we file or furnish with the SEC at the SEC’s Public Reference Room at 100 F Street, N.E., Washington, D.C. 20549 or may obtain information on the operation of the Public Reference Room by calling the SEC at 1-800-SEC-0330. Moreover, the SEC maintains an Internet site that contains reports, proxy and information statements, and other information regarding reports that we file or furnish electronically with them at www.sec.gov. Additional information related to Xenon is also available on SEDAR at www.sedar.com.

Item 1A. Risk Factors

You should carefully consider the following risk factors, in addition to the other information contained in this report, including the section of this report captioned “Management’s Discussion and Analysis of Financial Condition and Results of Operations” and our financial statements and related notes. If any of the events described in the following risk factors and the risks described elsewhere in this report occurs, our business, operating results and financial condition could be seriously harmed. This report on Form 10-K also contains forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from those anticipated in the forward-looking statements as a result of factors that are described below and elsewhere in this report.

Risks Related to Our Financial Condition and Capital Requirements

We have incurred significant losses since our inception and anticipate that we will continue to incur significant losses for the foreseeable future.

We are a clinical-stage biotechnology company and, other than the years ended December 31, 2014 and 2013, we have recorded net losses in each annual reporting period since inception in 1996, and we do not expect to have sustained profitability for the foreseeable future. We had net losses of \$15.8 million for the year ended December 31, 2015 and an accumulated deficit of \$119.7 million as of December 31, 2015.

We have devoted most of our financial resources to research and development, including our clinical and preclinical development activities. To date, we have financed our operations through the sale of equity securities, funding received from our licensees and collaborators and, to a lesser extent, government funding. Other than royalties we are eligible to receive from sales of Glybera under our license to uniQure Biopharma B.V., or uniQure, we have not generated any royalty revenue from product sales and our product candidates will require substantial additional investment before they will provide us with any product royalty revenue.

We expect to incur significant expenses and increasing operating losses for the foreseeable future as we:

- continue our research and preclinical and clinical development of our product candidates;
- expand the scope of our clinical studies for our current and prospective product candidates;
- initiate additional preclinical, clinical or other studies for our product candidates, including under our collaboration agreements;
 - change or add additional manufacturers or suppliers;
- seek regulatory and marketing approvals for any of our product candidates that successfully complete clinical studies;

- seek to identify and validate additional product candidates;
- acquire or in-license other product candidates and technologies;
- make milestone or other payments under our in-license agreements including, without limitation, our agreements with the University of British Columbia, or UBC, and the Memorial University of Newfoundland;
- maintain, protect and expand our intellectual property portfolio;
- establish a sales, marketing and distribution infrastructure to commercialize any products for which we or one of our collaborators may obtain marketing approval, and for which we have maintained commercial rights;
 - create additional infrastructure to support our operations as a public company and our product development and planned future commercialization efforts; and
- experience any delays or encounter issues with any of the above.

Our expenses could increase beyond expectations for a variety of reasons, including if we are required by the U.S. Food and Drug Administration, or FDA, the European Medicines Agency, or EMA, or other regulatory agencies, domestic or foreign, to perform clinical and other studies in addition to those that we currently anticipate. Our prior losses, combined with expected future losses, have had and will continue to have an adverse effect on our shareholders' equity.

Other than royalties we are eligible to receive from sales of Glybera, we have not generated any royalty revenue from product sales and may never become profitable on a U.S. GAAP basis.

Our ability to generate meaningful revenue and achieve profitability on a U.S. GAAP basis depends on our ability, alone or with strategic collaborators, to successfully complete the development of, and obtain the regulatory approvals necessary to commercialize, our product candidates. Substantially all of our revenue since inception has consisted of upfront and milestone payments associated with our collaboration and license agreements. Revenue from these agreements is dependent on successful development of our product candidates by us or our collaborators. Other than royalties we are eligible to receive from sales of Glybera under our license to uniQure, we have not generated any royalty revenue from product sales, and do not otherwise anticipate generating revenue from product sales for the foreseeable future, if ever. Commercial sales of Glybera commenced in November 2015, but we do not expect to receive significant revenue in the near-term from these sales. If any of our product candidates fail in clinical trials or do not gain regulatory approval, or if Glybera or any of our future products, if any, once approved, fail to achieve market acceptance or adequate market share, we may never become profitable. Although we were profitable for the years ended December 31, 2014 and 2013, we may not be able to sustain profitability in subsequent periods. Our ability to generate future revenue from product sales depends heavily on our success, and the success of our collaborators, in:

- completing research, preclinical and clinical development of our product candidates;
- seeking and obtaining regulatory and marketing approvals for product candidates for which we complete clinical studies;
- commercializing products for which we obtain regulatory and marketing approval, either with a collaborator or, if launched independently, by establishing sales, marketing and distribution infrastructure;
- negotiating favorable terms in any collaboration, licensing or other arrangements into which we may enter;
- obtaining market acceptance of products for which we obtain regulatory and marketing approval as therapies;
- addressing any competing technological and market developments;
- establishing and maintaining supply and manufacturing relationships with third parties that can provide adequate (in amount and quality) products and services to support clinical development and the market demand for any approved products in the future;
- developing sustainable, scalable, reproducible, and transferable manufacturing processes for any of our products approved in the future;
- maintaining, protecting, expanding and enforcing our portfolio of intellectual property rights, including patents, trade secrets and know-how;

- implementing additional internal systems and infrastructure, as needed; and
- attracting, hiring and retaining qualified personnel.

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The scope of our future revenue will also depend upon the size of any markets in which our product candidates receive approval and the availability of insurance coverage and the availability and amount of reimbursement from third-party payers for Glybera and future products, if any. If we are unable to achieve sufficient revenue to become profitable and remain so, our financial condition and operating results will be negatively impacted, and our trading price might be harmed.

We will likely need to raise additional funding, which may not be available on acceptable terms, if at all. Failure to obtain this necessary capital when needed may force us to delay, limit or terminate our product development efforts or other operations.

Since our inception, we have dedicated most of our resources to the discovery and development of our proprietary preclinical and clinical product candidates, and we expect to continue to expend substantial resources doing so for the foreseeable future. These expenditures will include costs associated with research and development, manufacturing of product candidates and products approved for sale, conducting preclinical experiments and clinical trials and obtaining and maintaining regulatory approvals, as well as commercializing any products later approved for sale. During the year ended December 31, 2015, we incurred approximately \$15.2 million of costs associated with research and development, exclusive of costs incurred by our collaborators in developing our product candidates.

Our current cash and cash equivalents and marketable securities are not expected to be sufficient to complete clinical development of any of our product candidates and prepare for commercializing any product candidate which receives regulatory approval. Accordingly, we will likely require substantial additional capital to continue our clinical development and potential commercialization activities. Our future capital requirements depend on many factors, including but not limited to:

- the number and characteristics of the future product candidates we pursue;
 - the scope, progress, results and costs of independently researching and developing any of our future product candidates, including conducting preclinical research and clinical trials;
- whether our existing collaborations continue to generate substantial milestone payments and, ultimately, royalties on future approved products for us;
- the timing of, and the costs involved in, obtaining regulatory approvals for any future product candidates we develop independently;
- the cost of future commercialization activities, including activities required pursuant to our option to co-promote TV-45070, if exercised by us, and the cost of commercializing any future products we develop independently that are approved for sale;
- the cost of manufacturing our future product candidates and products, if any;
 - our ability to maintain existing collaborations and to establish new collaborations, licensing or other arrangements and the financial terms of such agreements;
- the costs involved in preparing, filing, prosecuting, maintaining, defending and enforcing patents, including litigation costs and the outcome of such litigation; and
- the timing, receipt and amount of sales of, or royalties on, Glybera, and our future products, if any.

We are unable to estimate the funds we will actually require to complete research and development of our product candidates or the funds required to commercialize any resulting product in the future.

Based on our research and development plans and our timing expectations related to the progress of our programs, we expect that our existing cash and cash equivalents and marketable securities as of the date of this report and research funding that we expect to receive under our existing collaborations, will enable us to fund our operating expenses and capital expenditure requirements for at least the next 12 to 24 months.

Our operating plan may change as a result of many factors currently unknown to us, and we may need to seek additional funds sooner than planned, through public or private equity or debt financings, government or other third-party funding, marketing and distribution arrangements and other collaborations, strategic alliances and licensing arrangements or a combination of these approaches. Raising funds in the future may present additional challenges and future financing may not be available in sufficient amounts or on terms acceptable to us, if at all.

Raising additional capital may cause dilution to our existing shareholders, restrict our operations or require us to relinquish rights to our technologies or product candidates.

The terms of any financing arrangements we enter into may adversely affect the holdings or the rights of our shareholders and the issuance of additional securities, whether equity or debt, by us, or the possibility of such issuance, may cause the market price of our shares to decline. The sale of additional equity or convertible securities would dilute all of our shareholders. The incurrence of indebtedness would result in increased fixed payment obligations and, potentially, the imposition of restrictive covenants. Those covenants may include limitations on our ability to incur additional debt, limitations on our ability to acquire, sell or license intellectual property rights and other operating restrictions that could adversely impact our ability to conduct our business. We could also be required to seek funds through arrangements with collaborators or otherwise at an earlier stage than otherwise would be desirable resulting in the loss of rights to some of our product candidates or other unfavorable terms, any of which may have a material adverse effect on our business, operating results and prospects. In addition, any additional fundraising efforts may divert our management from their day-to-day activities, which may adversely affect our ability to develop and commercialize our product candidates.

Unstable market and economic conditions may have serious adverse consequences on our business and financial condition.

Global credit and financial markets experienced extreme disruptions at various points over the last decade, characterized by diminished liquidity and credit availability, declines in consumer confidence, declines in economic growth, increases in unemployment rates, and uncertainty about economic stability. If another such disruption in credit and financial markets and deterioration of confidence in economic conditions occurs, our business may be adversely affected. If the equity and credit markets were to deteriorate significantly in the future, it may make any necessary debt or equity financing more difficult to complete, more costly, and more dilutive. Failure to secure any necessary financing in a timely manner and on favorable terms could have a material adverse effect on our growth strategy, financial performance and share price and could require us to delay or abandon development or commercialization plans. In addition, there is a risk that one or more of our current collaborators, service providers, manufacturers and other partners would not survive or be able to meet their commitments to us under such circumstances, which could directly affect our ability to attain our operating goals on schedule and on budget.

We are subject to risks associated with currency fluctuations which could impact our results of operations.

As of December 31, 2015, approximately 70% of our cash and cash equivalents and marketable securities was denominated in Canadian dollars. Historically, the majority of our operating expenses have been denominated in Canadian dollars and the majority of our revenue has been denominated in U.S. dollars and we expect this trend to continue.

Prior to December 31, 2014, our functional currency was the Canadian dollar. On January 1, 2015, our functional currency changed from the Canadian dollar to the U.S. dollar based on our analysis of the changes in the primary economic environment in which we operate. As a result, changes in the exchange rate between the Canadian dollar and the U.S. dollar could materially impact our reported results of operations and distort period to period comparisons. In particular, to the extent that foreign currency-denominated (i.e., non-U.S. dollar) monetary assets do not equal the amount of our foreign currency denominated monetary liabilities, foreign currency gains or losses could arise and materially impact our financial statements. As a result of such foreign currency fluctuations, it could be more difficult to detect underlying trends in our business and results of operations. In addition, to the extent that fluctuations in currency exchange rates cause our results of operations to differ from our expectations or the expectations of our investors, the trading price of our common shares could be adversely affected.

From time to time, we may engage in exchange rate hedging activities in an effort to mitigate the impact of exchange rate fluctuations. For example, we maintain a natural currency hedge against fluctuations in the U.S./Canadian foreign exchange rate by matching the amount of U.S. dollar and Canadian dollar investments to the expected amount of future U.S. dollar and Canadian dollar obligations, respectively. Any hedging technique we implement may fail to be effective. If our hedging activities are not effective, changes in currency exchange rates may have a more significant impact on the trading price of our common shares.

Risks Related to Our Business

We, or our collaborators, may fail to successfully develop our product candidates.

Our product candidates, including TV-45070, GDC-0276, GDC-0310 and XEN801, and compounds in our preclinical and discovery pipeline, are in varying stages of development and will require substantial clinical development, testing and regulatory approval prior to commercialization. It may be several more years before these product candidates or any of our other product candidates receive marketing approval, if ever. If any of our product candidates fail to become approved products, our business, growth prospects, operating results and financial condition may be adversely affected and a decline of our common share price could result. For example, in July 2015, we and our partner Teva Pharmaceutical Industries Ltd., or Teva, announced top line results from a Phase 2b study designed to evaluate the safety and efficacy of topically applied TV-45070 in patients with chronic pain due to osteoarthritis, or OA, of the knee. Results from this trial showed that TV-45070 did not demonstrate statistically significant difference from placebo in efficacy endpoints of reductions in pain due to OA and neither we nor Teva have plans for further development of TV-45070 in OA, although clinical development of TV-45070 in post-herpetic neuralgia, or PHN, continues.

Our near-term operating revenue is partially dependent upon the regulatory and marketing efforts of uniQure, or its sublicensee, for the development and commercialization of Glybera.

Under the terms of our license agreement with uniQure, we rely on uniQure, or its sublicensees, to market Glybera and to obtain and maintain regulatory approval of Glybera. In July 2013, uniQure announced that it had granted to Chiesi Farmaceutici, S.p.A., or Chiesi, an Italian pharmaceutical firm, an exclusive license to commercialize Glybera in the European Union, or the EU, and certain other countries outside of North America and Japan. Commercial sales of Glybera commenced in November 2015. Despite the efforts of uniQure and Chiesi, Glybera may not gain market acceptance among physicians, patients, healthcare payers and the medical community. The commercial success of Glybera will depend on a number of factors, including:

- establishment and demonstration of clinical efficacy and safety and acceptance of the same by the medical community and regulatory authorities;
- commercialization of competing products;
- sufficient commercial supply of Glybera;
- cost-effectiveness of Glybera;
- regulatory authorities' final assessment of the benefit-risk analysis of Glybera;
- the availability of coverage and adequate reimbursement from third parties, including governmental payers, managed care organizations, and private health insurers;
- the relative cost, safety and efficacy of therapies that exist now or may be developed in the future;
- whether the product can be manufactured in commercial quantities at acceptable cost;
- marketing and distribution support for Glybera;
- cost of post-approval obligations in the EU including a post-approval clinical trial and market surveillance activities;
- maintaining the marketing approval under exceptional circumstances in the EU;
- the effect of current and future healthcare laws;
- the acceptance of gene therapies as a class of treatment; and
- any market or regulatory exclusivities applicable to the product.

Glybera is approved in the EU under exceptional circumstances and full approval may never be granted or the existing approval under exceptional circumstances could be revoked. As a condition to approval of Glybera, uniQure is required to complete a post-approval clinical trial and is required to implement a disease registry as well as implement risk management procedures, distribute educational materials to healthcare professionals and patients, implement an additional manufacturing process step, comply with certain notification obligations and undergo annual reassessment,

any negative outcome of which could potentially lead to a withdrawal of marketing approval for Glybera.

Any failure of uniQure or its sublicensee to successfully commercialize Glybera or revocation of Glybera's marketing approval in the EU could have a material adverse effect on our business, growth prospects, operating results and financial condition and could result in a substantial decline in the price of our common shares.

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We and our collaborators face substantial competition in the markets for our product candidates, which may result in others discovering, developing or commercializing products before us or doing so more successfully than we or our collaborators do.

The biotechnology and pharmaceutical industries are characterized by rapidly advancing technologies, intense competition and a strong emphasis on proprietary products. We face potential competition in target discovery and product development from many different approaches and sources, including major pharmaceutical, specialty pharmaceutical and biotechnology companies, academic institutions and governmental agencies and public and private research institutions. Any product candidates that we or our collaborators successfully develop and commercialize will compete with existing products and any new products that may become available in the future.

The key competitive factors affecting the success of all of our product candidates, if approved, are likely to be their efficacy, safety, convenience and price; the effectiveness and safety of alternative products; the level of generic competition; and the availability of coverage and adequate reimbursement from government and other third-party payers.

With respect to target discovery activities, competitors and other third parties, including academic and clinical researchers, may access rare families and identify novel targets for drug development before we do.

Many of the companies against which we are competing or against which we may compete in the future have significantly greater financial resources and expertise in research and development, manufacturing, preclinical testing, conducting clinical trials, obtaining regulatory approvals and marketing approved products than we, or our collaborators, do. Mergers and acquisitions in the pharmaceutical and biotechnology industries may result in even more resources being concentrated among a smaller number of our competitors. Smaller or early stage companies may also prove to be significant competitors, particularly through collaboration arrangements with large and established companies.

Our commercial opportunities could be reduced or eliminated if our competitors develop and commercialize products or therapies that are safer, more effective, have fewer or less severe side effects, are more convenient or are less expensive than any products that we may develop. Our competitors also may obtain FDA, EMA or other regulatory approval for their products more rapidly than we may obtain approval for ours, which could result in our competitors establishing a strong market position before we are able to enter the market. In addition, our ability to compete may be affected by decisions made by insurers or other third party payers.

To the extent that we are unable to compete effectively against one or more of our competitors in these areas, our business will not grow and our financial condition, results of operations and common share price may suffer.

There are no approved gene therapies currently on the market for lipoprotein lipase deficiency, or LPLD, in the U.S. The current management of LPLD consists of strict adherence to an extremely low-fat diet, but compliance with such a diet is challenging. Lipid-lowering drugs are generally not effective for treating LPLD. We are not aware of any other drugs or therapies currently in development that treat LPLD by using the lipoprotein lipase, or LPL, sequence containing the LPL^{S447X} genetic variant or otherwise.

Drug discovery and development for various pain applications is intensely competitive. There are a large number of approved products for neuropathic pain, inflammatory pain and other pain indications. These approved products include capsaicin, celecoxib, lidocaine, narcotic analgesics and pregabalin. We are also aware of clinical-stage development programs at several pharmaceutical and biotechnology companies that are developing Nav1.7 inhibitors or other sodium channel inhibitors for the treatment of pain, including Biogen Inc., Dainippon Sumitomo Co., Ltd., Eli Lilly and Company, Merck & Co., Inc., or Merck, NeuroQuest Inc., and Vertex Pharmaceuticals Inc. Moreover,

we are aware of various other product candidates in development that target other mechanisms of action to treat various pain indications, including calcium channel inhibitors, nerve growth factor inhibitors and P2X purinoceptor 3 inhibitors.

If XEN801 were approved for the treatment of acne, we anticipate it would compete with other approved prescription acne products including topical retinoids, oral hormonal therapies, topical and oral antimicrobials, and oral isotretinoin. In addition to approved prescription therapies, there are a wide range of over-the-counter, or OTC, treatments targeted at treating acne. Additionally, there are a number of prescription products that are used “off-label” for the treatment of acne. We are also aware of several products in clinical development that could potentially compete with XEN801, including products in development from Allergan PLC, AOBiome LLC, Braintree Laboratories Inc., Cassiopea SpA, Dermira Inc., Foamix Pharmaceuticals Ltd., Galderma SA, Mimetica Pty Ltd, Novan Therapeutics, Phosphagenics Ltd, Valeant Pharmaceuticals, and XBiotech Inc.

The novelty of gene therapy products and their lack of a commercial track record may hinder market acceptance of Glybera among physicians, patients, healthcare payers and the medical community.

Glybera is the first gene therapy product approved in the EU, and no gene therapy product has been approved in the U.S. Because Glybera is the first gene therapy to be marketed in the EU, gaining market acceptance and overcoming any safety or efficacy concerns may be more challenging than for a more traditional therapy. Glybera's commercial success will depend, in part, on the success of efforts to educate the market regarding gene therapy products. In particular, the success of Glybera will depend upon physicians who treat patients with LPLD, prescribing Glybera. With respect to Glybera and any other gene therapy products we or a collaborator may develop, public perception may be influenced by claims that gene therapy is unsafe, and, if so, gene therapy may not gain the acceptance of the public or the medical community.

We have no marketed products and have not yet advanced a product candidate beyond Phase 2 clinical trials, which makes it difficult to assess our ability to develop our future product candidates and commercialize any resulting products independently.

We have no experience in Phase 3 and later stage clinical development, and related regulatory requirements or the commercialization of products. uniQure controls and has been responsible for the development and commercialization of Glybera, Teva is responsible for the on-going clinical development of TV-45070, and Genentech Inc., or Genentech, is responsible for the on-going clinical development of GDC-0276 and GDC-0310. Accordingly, we have not yet demonstrated our ability to independently and repeatedly conduct clinical development after Phase 2, obtain regulatory approval and commercialize therapeutic products. We will need to develop such abilities if we are to execute on our business strategy to selectively develop and independently commercialize product candidates for orphan and niche indications. To execute on our business plan for the development of independent programs, we will need to successfully:

- execute our clinical development plans for later-stage product candidates;
- obtain required regulatory approvals in each jurisdiction in which we will seek to commercialize products;
- build and maintain appropriate sales, distribution and marketing capabilities;
- gain market acceptance for our future products, if any; and
- manage our spending as costs and expenses increase due to clinical trials, regulatory approvals and commercialization activities.

If we are unsuccessful in accomplishing these objectives, we would not be able to develop and commercialize any future orphan and niche disease product candidates independently, and could fail to realize the potential advantages of doing so.

If we are not successful in leveraging our Extreme Genetics discovery platform to discover product candidates in addition to TV-45070, GDC-0276, GDC-0310 and XEN801, our ability to expand our business and achieve our strategic objectives may be impaired.

We rely on our Extreme Genetics discovery platform to identify validated drug targets and develop new product candidates. To date, our Extreme Genetics discovery platform has yielded one approved product, Glybera, and four clinical development candidates TV-45070, GDC-0276, GDC-0310 and XEN801. Use of our discovery platform requires substantial technical, financial and human resources, regardless of whether we identify any novel drug targets. Our Extreme Genetics discovery platform may initially show promise in identifying additional potential product candidates, yet fail to yield viable product candidates for clinical development or commercialization. Such failure may occur for many reasons, including the following: any product candidate may, on further study, be shown to have serious or unexpected side effects or other characteristics that indicate it is unlikely to be safe or otherwise does not meet applicable regulatory criteria; and any product candidate may not be capable of being produced in

commercial quantities at an acceptable cost, or at all.

If we are unable to identify additional product candidates suitable for clinical development and commercialization, we may not be able to obtain product revenue in future periods, which likely would result in significant harm to our financial position and adversely impact our trading price.

Our approach to drug discovery is unproven, and we do not know whether we will be able to develop any products of commercial value.

Our Extreme Genetics discovery platform may not reproducibly or cost-effectively result in the discovery of product candidates and development of commercially viable products that safely and effectively treat human disease.

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There are various challenges in utilizing our Extreme Genetics discovery platform to successfully identify novel drug targets, including locating families suffering from rare disorders and severe phenotypes, entering into agreements with foreign collaborators, complying with various domestic and foreign privacy laws, accessing required technologies in a timely manner and transporting DNA across national borders.

To date, only Glybera has been both developed using our Extreme Genetics discovery platform and approved for commercial sale. If the use of our Extreme Genetics discovery platform fails to identify novel targets for drug discovery, or such targets prove to be unsuitable for treating human disease, or we are unable to develop product candidates with specificity and selectivity for such targets, we will fail to develop viable products. If we fail to develop and commercialize viable products, we will not achieve commercial success.

We may encounter difficulties in managing our growth, including headcount, and expanding our operations successfully.

Our business strategy involves continued development and, where development is successful, commercialization of select successfully developed product candidates for orphan and niche indications independently. In order to execute on this strategy, we will need to build out a regulatory, sales, manufacturing, distribution and marketing infrastructure and expand our development capabilities or contract with third parties to provide these capabilities and infrastructure for us. To achieve this, we will need to identify, hire and integrate personnel who have not worked together as a group previously. We anticipate that we may need to hire additional accounting, legal and financial staff with appropriate public company experience and technical accounting and other knowledge to address the added burdens of operating as a newly public company. There are likely to be infrastructure costs associated with public company compliance as well.

As our operations expand, we expect that we will need to manage additional relationships with various strategic collaborators, suppliers and other third parties.

Drs. Simon Pimstone and Y. Paul Goldberg each devote a small amount of their time to clinical work outside of their duties at our company, conducting, generally, two to three outpatient clinics per month. Future growth will impose significant added responsibilities on members of management, and our management may need to divert a disproportionate amount of its attention away from our day-to-day activities and devote a substantial amount of time to managing these growth activities.

If we are to effectively manage our growth, our expenses may increase more than expected, our ability to generate and grow revenue could be reduced, and we may not be able to implement our business strategy. Our future financial performance and our ability to commercialize product candidates and compete effectively will depend, in part, on our ability to effectively manage any future growth.

If we fail to attract and retain senior management and key personnel, we may be unable to successfully develop our product candidates, perform our obligations under our collaboration agreements, conduct our clinical trials and commercialize our product candidates.

Our success depends in part on our continued ability to attract, retain and motivate highly qualified management, clinical and scientific personnel.

We could experience difficulties attracting and retaining qualified employees as competition for qualified personnel in the biotechnology and pharmaceutical field is intense. We are highly dependent upon our senior management, particularly Dr. Pimstone, our Chief Executive Officer and President; Mr. Ian Mortimer, our Chief Financial Officer and Chief Operating Officer; and Dr. Goldberg, our Vice President, Clinical Development, as well as other

employees. In the near future, the loss of services of any of these individuals or one or more of our other members of senior management could materially delay or even prevent the successful development of our product candidates.

In addition, we will need to hire additional personnel as we expand our clinical development activities and develop commercial capabilities, including a sales infrastructure to support our independent commercialization efforts. We may not be able to attract and retain personnel on acceptable terms given the competition among numerous pharmaceutical and biotechnology companies for individuals with similar skill sets. The inability to recruit or loss of the services of any executive or key employee may impede the progress of our research, development and commercialization objectives.

Our employees, collaborators and other personnel may engage in misconduct or other improper activities, including non-compliance with regulatory standards and requirements and insider trading.

We are exposed to the risk of fraud or other misconduct by our employees, collaborators, vendors, principal investigators, consultants and commercial partners. Misconduct by these parties could include intentional failures to comply with the regulations of the FDA, EMA and other non-U.S. regulators, provide accurate information to the FDA, EMA and other non-U.S. regulators, comply with data privacy and security and healthcare fraud and abuse laws and regulations in the U.S. and abroad, report financial information or data accurately or disclose unauthorized activities to us. In particular, sales, marketing and business arrangements in the healthcare industry are subject to extensive laws and regulations intended to prevent fraud, misconduct, kickbacks, self-dealing and other abusive practices. Additionally, laws regarding data privacy and security, including the federal Health Insurance Portability and Accountability Act of 1996, or HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act of 2009, or HITECH, as well as comparable laws in non-U.S. jurisdictions, may impose obligations with respect to safeguarding the privacy, use, security and transmission of individually identifiable health information such as genetic material or information we obtain through our direct-to-patient web-based recruitment approach for identifying patients with rare or extreme phenotypes.

Various 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. Any misconduct could also involve the improper use of information obtained in the course of clinical studies, which could result in regulatory sanctions and cause serious harm to our reputation. We have adopted a code of conduct applicable to all of our employees, but it is not always possible to identify and deter employee misconduct, and the precautions we take to detect and prevent this activity may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from governmental investigations or other actions or lawsuits stemming from a failure to comply with these 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 fines or other sanctions.

Our business and operations could suffer in the event of system failures.

Computer system, network or telecommunications failures due to events such as damage from malware, unauthorized access, terrorism, war, or natural disasters could interrupt our internal or partner operations. For example, the loss of preclinical trial data or data from completed or ongoing clinical trials for our product candidates could result in delays in our regulatory filings and development efforts and significantly increase our costs. To the extent that any disruption or security breach were to result in a loss of or damage to our data, or inappropriate disclosure of confidential or proprietary information, we could incur liability and the development of our product candidates could be delayed. While we have implemented security measures and, to date, have not detected a cyber security breach nor experienced a material system failure, our internal computer systems and those of our contractors and consultants are vulnerable to damage from these events.

A variety of risks associated with international operations could materially adversely affect our business.

Glybera has been approved for commercial sale in the EU by the EMA, subject to uniQure's compliance with certain post-approval reporting and monitoring obligations. Our collaborator for TV-45070, Teva, is based in Israel and a significant portion of the research and development activities under our collaboration with Teva are performed outside of North America. If we continue to engage in significant cross-border activities, we will be subject to risks related to international operations, including:

- different regulatory requirements for maintaining approval of drugs and biologics in foreign countries;

- reduced protection for intellectual property rights in certain countries;
- unexpected changes in tariffs, trade barriers and regulatory requirements;
- economic weakness, including inflation, political instability or open conflict in particular foreign economies and markets;
- compliance with tax, employment, immigration and labor laws for employees living or traveling abroad;
- foreign currency fluctuations, which could result in increased operating expenses and reduced revenue, and other obligations of doing business in another country;
- workforce uncertainty in countries where labor unrest is more common than in North America;
- likelihood of potential or actual violations of domestic and international anti-corruption laws, such as the U.S. Foreign Corrupt Practices Act and the U.K. Bribery Act, or of U.S. and international export control and sanctions regulations, which likelihood may increase with an increase of operations in foreign jurisdictions;

- tighter restrictions on privacy and the collection and use of data, including genetic material, may apply in jurisdictions outside of North America, where we find some of the families with individuals that exhibit the severe phenotypes that we study; and
- business interruptions resulting from geopolitical actions, including war and terrorism, or natural disasters including earthquakes, typhoons, floods and fires.

If any of these issues were to occur, our business could be materially harmed.

U.S. Holders of our shares may suffer adverse tax consequences if we are characterized as a passive foreign investment company.

Generally, for any taxable year in which 75% or more of our gross income is passive income, or at least 50% of the average quarterly value of our assets (which may be determined in part by the market value of our common shares, which is subject to change) are held for the production of, or produce, passive income, we would be characterized as a passive foreign investment company, or PFIC, for U.S. federal income tax purposes. Based on the composition of our gross income and gross assets and the nature of our business, we do not believe that we were a PFIC for the taxable years ended December 31, 2015 and 2014, although we could be a PFIC in one or more subsequent years. Our status as a PFIC is a fact-intensive determination made on an annual basis and we cannot provide any assurance regarding our PFIC status for future taxable years.

If we are a PFIC for any subsequent year, U.S. Holders of our common shares may suffer adverse tax consequences. Gains realized by non-corporate U.S. Holders on the sale of our common shares would be taxed as ordinary income, rather than as capital gain, and the preferential tax rate applicable to dividends received on our common shares would be lost. Interest charges would also be added to taxes on gains and dividends realized by all U.S. Holders.

A U.S. Holder may avoid these adverse tax consequences by timely making a qualified electing fund election. For each year that we would meet the PFIC gross income or asset test, an electing U.S. Holder would be required to include in gross income its pro rata share of our net ordinary income and net capital gains, if any. A U.S. Holder may make a qualified electing fund election only if we commit to provide U.S. Holders with their pro rata share of our net ordinary income and net capital gains. If we are a PFIC in the current or a future tax year, we will provide our U.S. Holders with the information that is necessary in order for them to make a qualified electing fund election and to report their common shares of ordinary earnings and net capital gains for each year for which we are a PFIC.

A U.S. Holder may also mitigate the adverse tax consequences if we are a PFIC by timely making a mark-to-market election. Generally, for each year that we would meet the PFIC gross income or asset test, an electing U.S. Holder would include in gross income the increase in the value of its shares during each of its taxable years and deduct from gross income the decrease in the value of such shares during each of its taxable years. A mark-to-market election may be made and maintained only if our common shares are regularly traded on a qualified exchange, including The NASDAQ Global Market, or NASDAQ. Whether our common shares are regularly traded on a qualified exchange is an annual determination based on facts that, in part, are beyond our control. Accordingly, a U.S. Holder might not be eligible to make a mark-to-market election to mitigate the adverse tax consequences if we are characterized as a PFIC.

We may become subject to income tax in jurisdictions in which we are organized or operate, including the United States, which would reduce our future earnings.

There is a risk that we may become subject to income tax in jurisdictions outside of Canada, including the United States, if under the laws of any such jurisdiction, we are considered to be carrying on a trade or business there or earn income that is considered to be sourced there and we do not qualify for an exemption. In jurisdictions where we do not believe we are subject to tax, we can provide no certainty that tax authorities in those jurisdictions will not subject one or more tax years to examination. Tax examinations are often complex as tax authorities may disagree with the

treatment of items reported by us, the result of which could have a material adverse effect on our operating results and financial condition.

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Acquisitions or joint ventures could disrupt our business, cause dilution to our shareholders and otherwise harm our business.

We actively evaluate various strategic transactions on an ongoing basis and may acquire other businesses, products or technologies as well as pursue strategic alliances, joint ventures or investments in complementary businesses. Any of these transactions could be material to our financial condition and operating results and expose us to many risks, including:

- disruption in our relationships with collaborators or suppliers as a result of such a transaction;
- unanticipated liabilities related to acquired companies;
- difficulties integrating acquired personnel, technologies and operations into our existing business;
- retention of key employees;
- diversion of management time and focus from operating our business to management of strategic alliances or joint ventures or acquisition integration challenges;
- increases in our expenses and reductions in our cash available for operations and other uses; and
- possible write-offs or impairment charges relating to acquired businesses.

Foreign acquisitions involve unique risks in addition to those mentioned above, including those related to integration of operations across different cultures and languages, currency risks and the particular economic, political and regulatory risks associated with specific countries.

Also, the anticipated benefit of any strategic alliance, joint venture or acquisition may not materialize. Future acquisitions or dispositions could result in potentially dilutive issuances of our equity securities, the incurrence of debt, contingent liabilities or amortization expenses or write-offs of goodwill, any of which could harm our financial condition. We cannot predict the number, timing or size of future joint ventures or acquisitions, or the effect that any such transactions might have on our operating results.

Risks Related to Development, Clinical Testing and Regulatory Approval of Our Product Candidates

The regulatory approval processes of the FDA, EMA and regulators in other jurisdictions are lengthy, time-consuming and inherently unpredictable. If we, or our collaborators, are unable to obtain timely regulatory approval for our product candidates, our business will be substantially harmed.

The regulatory approval process is expensive and the time required to obtain approval from the FDA, EMA or other regulatory authorities in other jurisdictions to sell any product is uncertain and may take years. Whether regulatory approval will be granted is unpredictable and depends upon numerous factors, including the substantial discretion of the regulatory authorities. Approval policies, regulations, or the type and amount of preclinical and clinical data necessary to gain approval may change during the course of a product candidate's clinical development and may vary among jurisdictions. Other than for Glybera in the EU, neither we nor our collaborators have obtained regulatory approval for any of our product candidates. It is possible that none of our existing product candidates or any of our future product candidates will ever obtain regulatory approval, even if we expend substantial time and resources seeking such approval.

Our product candidates could fail to receive regulatory approval for many reasons, including the following:

- the FDA, EMA or other regulatory authorities may disagree with the design or implementation of our or our collaborators' clinical trials;
- we or our collaborators may be unable to demonstrate to the satisfaction of the FDA, EMA or other regulatory authorities that a product candidate is safe and effective for its proposed indication;
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the results of clinical trials may not meet the level of statistical significance required by the FDA, EMA or other regulatory authorities for approval;

- we, or our collaborators, may be unable to demonstrate that a product candidate's clinical and other benefits outweigh its safety risks;
- the FDA, EMA or other regulatory authorities may disagree with our or our collaborators' interpretation of data from preclinical studies or clinical trials;
- the data collected from clinical trials of our product candidates may not be sufficient to support the submission of a New Drug Application, or NDA, or other submission or to obtain regulatory approval in the U.S. or elsewhere;

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- the FDA, EMA or other regulatory authorities may fail to approve the manufacturing processes or facilities of third-party manufacturers with which we or our collaborators contract for clinical and commercial supplies; and
- the approval policies or regulations of the FDA, EMA or other regulatory authorities outside of the U.S. may significantly change in a manner rendering our or our collaborators' clinical data insufficient for approval.

Even if we, or our collaborators, obtain approval for a particular product, regulatory authorities may grant approval contingent on the performance of costly post-approval clinical trials, or may approve a product with a label that does not include the labeling claims necessary or desirable for the successful commercialization of that product.

Clinical drug development involves a lengthy and expensive process with uncertain timelines and uncertain outcomes. If clinical trials are prolonged or delayed, we, or our collaborators, may be unable to commercialize our product candidates on a timely basis.

Clinical testing of product candidates is expensive and, depending on the stage of development, can take a substantial period of time to complete. Clinical trial outcomes are inherently uncertain, and failure can occur at any time during the clinical development process.

Clinical trials can be halted or delayed for a variety of reasons, including those related to:

- side effects or adverse events in study participants presenting an unacceptable safety risk;
- inability to reach agreement with prospective contract research organizations, or CROs, and clinical trial sites, or the breach of such agreements;
- failure of third-party contractors, such as CROs, or investigators to comply with regulatory requirements;
- delay or failure in obtaining the necessary approvals from regulators or institutional review boards, or IRBs, in order to commence a clinical trial at a prospective trial site, or their suspension or termination of a clinical trial once commenced;
- a requirement to undertake and complete additional preclinical studies to generate data required to support the submission of an NDA;
- inability to enroll sufficient patients to complete a protocol, particularly in orphan diseases;
- difficulty in having patients complete a trial or return for post-treatment follow-up;
 - clinical sites deviating from trial protocol or dropping out of a trial;
- problems with drug product or drug substance storage and distribution;
- adding new clinical trial sites;
- our inability to manufacture, or obtain from third parties, adequate supply of drug substance or drug product sufficient to complete our preclinical studies and clinical trials; and
- governmental or regulatory delays and changes in regulatory requirements, policy and guidelines.

The results of any Phase 3 or other pivotal clinical trial may not be adequate to support marketing approval. These clinical trials are lengthy and, with respect to non-orphan indications, usually involve many hundreds to thousands of patients. In addition, if the FDA, EMA or another applicable regulator disagrees with our or our collaborator's choice of the key testing criterion, or primary endpoint, or the results for the primary endpoint are not robust or significant relative to the control group of patients not receiving the experimental therapy, such regulator may refuse to approve our product candidate in the region in which it has jurisdiction. The FDA, EMA or other applicable non-U.S. regulators also may require additional clinical trials as a condition for approving any of these product candidates.

We could also encounter delays if a clinical trial is suspended or terminated by us, by our collaborators, by the IRBs of the institutions in which such trial is being conducted, by any Data Safety Monitoring Board for such trial, or by the FDA, EMA or other regulatory authorities. Such authorities may impose such a suspension or termination 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, EMA or other regulatory authorities resulting in the imposition of a clinical hold, product candidate manufacturing problems, 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. In addition, delays can occur due to safety concerns arising from trials or other clinical data regarding another company's product candidate in the same compound class as one of ours.

If we or our collaborators experience delays in the completion of, or termination of, any clinical trial of one of our product candidates, the commercial prospects of the product candidate will be harmed, could shorten the patent protection period during which we may have the exclusive right to commercialize our products and our or our collaborators' ability to commence product sales and generate product revenue from the product will be delayed. In addition, any delays in completing our clinical trials will increase our costs and slow down our product candidate development and approval process. Any of these occurrences may harm our business, financial condition and prospects significantly. 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.

Our TV-45070, GDC-0276 and GDC-0310 product candidates for treatment of pain and XEN801 product candidate for the treatment of acne target novel molecular mechanisms. Regulatory authorities may require more extensive studies of the long-term effects of such product candidates for regulatory approval, which could delay development of our product candidates or our future product candidates based on novel mechanisms.

Our clinical trials may fail to demonstrate adequately the safety and efficacy of our product candidates, which could prevent or delay regulatory approval and commercialization.

Before obtaining regulatory approvals for the commercial sale of our products, we must demonstrate through lengthy, complex and expensive preclinical testing and clinical trials that the product candidate is both safe and effective for use in each target indication. Clinical trials often fail to demonstrate safety and efficacy of the product candidate studied for the target indication. Most product candidates that commence clinical trials are never approved as products. For example, in July 2015, we and our partner Teva announced top line results from a Phase 2b study designed to evaluate the safety and efficacy of topically applied TV-45070 in patients with chronic pain due to OA of the knee. Results from this trial showed that TV-45070 did not demonstrate statistically significant difference from placebo in efficacy endpoints of reductions in pain due to OA and neither we nor Teva have plans for further development of TV-45070 in OA, although clinical development of TV-45070 in PHN continues.

In the case of some of our product candidates, we are seeking to develop treatments for diseases for which there is relatively limited clinical experience, and, in some cases our clinical trials use novel end points and measurement methodologies or subjective patient feedback, which adds a layer of complexity to our clinical trials and may delay regulatory approval. In addition, our focus on orphan and niche markets may cause us to select target indications that are in more challenging therapeutic areas. For example, clinical trials for pain, the indication for which TV-45070, GDC-0276 and GDC-0310 are being developed, are inherently difficult to conduct. The primary measure of pain is subjective patient feedback, which can be influenced by factors outside of our control, and can vary widely from day to day for a particular patient, and from patient to patient and site to site within a clinical study. The placebo effect also tends to have a more significant impact on pain trials.

If our product candidates are not shown to be both safe and effective in clinical trials, we will not be able to obtain regulatory approval or commercialize these product candidates and products. In such case, we would need to develop other compounds and conduct associated preclinical testing and clinical trials, as well as potentially seek additional financing, all of which would have a material adverse effect on our business, growth prospects, operating results, financial condition and results of operations.

We may find it difficult to enroll patients in our clinical studies, including for orphan or niche indications, which could delay or prevent clinical studies of our product candidates.

We may not be able to identify, recruit and enroll a sufficient number of patients, or those with required or desired characteristics to achieve diversity in a study, to complete our clinical studies in a timely manner. Patient enrollment for clinical trials for orphan and niche indications and for more prevalent conditions is affected by factors including:

- severity of the disease under investigation;
- design of the study protocol;

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- size of the patient population;
- eligibility criteria for the study in question;
- perceived risks and benefits of the product candidate under study;
- proximity and availability of clinical study sites for prospective patients;
- availability of competing therapies and clinical studies;
- efforts to facilitate timely enrollment in clinical studies; and
- patient referral practices of physicians.

The limited patient populations in orphan and niche indications present significant recruitment challenges for clinical trials. For example, studies estimate the prevalence of LPLD to be approximately 1:1,000,000 and the prevalence of Dravet Syndrome, or DS, to be 7,500-15,000 patients in the U.S. Many of these patients may not be suitable or available for clinical trials. This means that we or our collaborators generally will have to run multi-site and potentially multi-national trials, which can be expensive and require close coordination and supervision. If we experience delays in completing our clinical trials, such delays could result in increased costs, delays in advancing our product development, delays in testing the effectiveness of our technology or termination of the clinical studies altogether.

If we fail to obtain or maintain orphan drug designation or other regulatory exclusivity for some of our product candidates, our competitive position would be harmed.

A product candidate that receives orphan drug designation can benefit from a streamlined regulatory process as well as potential commercial benefits following approval. Currently, this designation provides market exclusivity in the U.S. and the EU for seven years and ten years, respectively, if a product is the first such product approved for such orphan indication. This market exclusivity does not, however, pertain to indications other than those for which the drug was specifically designated in the approval, nor does it prevent other types of drugs from receiving orphan designations or approvals in these same indications. Further, even after an orphan drug is approved, the FDA can subsequently approve a drug with similar chemical structure for the same condition if the FDA concludes that the new drug is clinically superior to the orphan product or a market shortage occurs.

In the EU, orphan exclusivity may be reduced to six years if the drug no longer satisfies the original designation criteria or can be lost altogether if the marketing authorization holder consents to a second orphan drug application or cannot supply enough drug, or when a second applicant demonstrates its drug is “clinically superior” to the original orphan drug. TV-45070 has received both fast track and orphan drug designations for the treatment of erythromelalgia, or EM, by the FDA. If we seek orphan drug designations for other indications or in other jurisdictions, such as for TV-45070 in the EU, we may fail to receive such orphan drug designations and, even if we succeed, such orphan drug designations may fail to result in or maintain orphan drug exclusivity upon approval, which would harm our competitive position.

Results of earlier clinical trials may not be predictive of the results of later-stage clinical trials.

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. Interpretation of results from early, usually smaller, studies that suggest a clinically meaningful response in some patients, requires caution. Results from later stages of clinical trials enrolling more patients may fail to show the desired safety and efficacy results or otherwise fail to be consistent with the results of earlier trials of the same product candidates. Later clinical trial results may not replicate earlier clinical trials for a variety of reasons, including differences in trial design, different trial endpoints (or lack of trial endpoints in exploratory studies), patient population, number of patients, patient selection criteria, trial duration, drug dosage and formulation and lack of statistical power in the earlier studies. These uncertainties are enhanced where the diseases under study lack established clinical endpoints and validated measures of efficacy, as is often the case with orphan diseases for which no drugs have been developed previously. For example, our results for two small exploratory

clinical trials for primary EM pain, one using a topical formulation and the other an oral formulation of TV-45070, used novel measures of efficacy assessment. While these studies provided promising results, further larger clinical trials will be necessary to confirm and extend these observations.

Changes in methods of product candidate manufacturing or formulation may result in additional costs or delay.

As product candidates are developed through preclinical to late stage clinical trials towards approval and commercialization, it is common that various aspects of the development program, such as manufacturing methods and formulation, are altered along the way in an effort to optimize processes and results. Such changes carry the risk that they will not achieve these intended objectives. Any of these changes could cause our product candidates to perform differently and affect the results of planned clinical trials or other future clinical trials conducted with the altered materials. This could delay completion of clinical trials, require the conduct of bridging clinical trials or the repetition of one or more clinical trials, increase clinical trial costs, delay approval of our product candidates and/or jeopardize our or our collaborators' ability to commence product sales and generate revenue.

Even if we obtain and maintain approval for our product candidates from one jurisdiction, we may never obtain approval for our product candidates in other jurisdictions, which would limit our market opportunities and adversely affect our business.

Sales of our approved products are, and will be, subject to U.S. and fo