GENOCEA BIOSCIENCES, INC.
Form 10-K
February 16, 2018

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

FORM 10-K
(Mark One)
x ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2017
or
o TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the transition period from to
Commission file number 001-36289
Genocea Biosciences, Inc.
(Exact name of registrant as specified in its charter)

Delaware	51-0596811
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)
100 Acorn Park Drive Cambridge, Massachusetts	02140
(Address of principal executive offices)	(Zip Code)

Registrant's telephone number, including area code: (617) 876-8191
Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Name of each exchange on which registered
Common Stock, $0.001 par value	Nasdaq Global Market

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

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Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. o Yes x No
Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. o Yes x 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. x Yes o 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 registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. x
Indicate by check mark whether the registrant has submitted electronically and posted on its corporate website, 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). x Yes o No
Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company or an emerging growth company. See definitions of "large accelerated filer," "accelerated filer," "smaller reporting company" and "emerging growth company" in Rule 12b-2 of the Exchange Act. (Check one):

Large accelerated filer o	Accelerated filer x
Non-accelerated filer o	Smaller reporting company o
(Do not check if a smaller reporting company)	Emerging growth company x

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

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

The aggregate market value of the voting and non-voting common equity held by non-affiliates of the registrant, based on the closing price for such stock as reported on The Nasdaq Global Market on June 30, 2017, the last business day of the registrant's most recently completed second quarter, was: $100,317,709.

The number of shares outstanding of the registrant's common stock as of February 14, 2018 was 82,099,898.

TABLE OF CONTENTS

FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K contains forward-looking statements that involve substantial risks and uncertainties. Forward-looking statements are neither historical facts nor assurances of future performance. Instead, they are based on our current beliefs, expectations and assumptions regarding the future of our business, future plans and strategies, our clinical results and other future conditions. The words “anticipate”, “believe”, “contemplate”, “continue”, “could”, “estimate”, “expect”, “forecast”, “goal”, “intend”, “may”, “plan”, “potential”, “predict”, “project”, “should”, “target”, negative of these terms or other similar expressions are intended to identify forward-looking statements, although not all forward-looking statements contain these identifying words.

The forward-looking statements in this Annual Report on Form 10-K include, among other things, statements about:

- our estimates regarding the timing and amount of funds we require to file our investigational new drug ("IND") application and initiate clinical trials for GEN-009 and to continue our investments in immuno-oncology;
- our estimate for when we will require additional funding;
- our plans to commercialize GEN-009 and our other product candidates;
- the timing of, and our ability to, obtain and maintain regulatory approvals for our product candidates;
- the rate and degree of market acceptance and clinical utility of any approved product candidate;
- the potential benefits of strategic partnership agreements and our ability to enter into strategic partnership arrangements;
- our ability to quickly and efficiently identify and develop product candidates;
- our commercialization, marketing and manufacturing capabilities and strategy;
- our intellectual property position; and
- our estimates regarding expenses, future revenues, capital requirements, the sufficiency of our current and expected cash resources and our need for additional financing.

We may not actually achieve the plans, intentions or expectations disclosed in our forward-looking statements, and you should not place undue reliance on our forward-looking statements. Actual results or events could differ materially from the plans, intentions and expectations disclosed in the forward-looking statements we make. We have included important factors in the cautionary statements included in this Annual Report on Form 10-K, particularly in the “Risk Factors” section, that we believe could cause actual results or events to differ materially from the forward-looking statements that we make. Our forward-looking statements do not reflect the potential impact of any future acquisitions, mergers, dispositions, joint ventures or investments we may make or collaborations or strategic partnerships we may enter into.

You should read this Annual Report on Form 10-K and the documents that we have filed as exhibits to the Annual Report on Form 10-K completely and with the understanding that our actual future results may be materially different from what we expect. We do not assume any obligation to update any forward-looking statements, whether as a result of new information, future events or otherwise, except as required by law.

PART I

Item 1. Business

Unless the context requires otherwise, references in this Annual Report on Form 10-K to “Genocea”, “we”, “us” and “our” refer to Genocea Biosciences, Inc.

Overview

We are a biopharmaceutical company that discovers and develops novel cancer vaccines. We use our proprietary discovery platform, ATLAS, to recall a patient’s pre-existing CD4+ and CD8+ T cell immune responses to their tumor to identify antigens for inclusion in vaccines that are designed to act through T cell (or cellular) immune responses. We believe that using ATLAS to identify antigens for inclusion in cancer vaccines could lead to more immunogenic and efficacious cancer vaccines.

In September 2017, we announced a strategic shift to immuno-oncology and a focus on the development of neoantigen cancer vaccines. Currently, all of our research programs and product candidates in active development are at the preclinical stage. Our most advanced program is our preclinical immuno-oncology program, GEN-009, a neoantigen cancer vaccine. The GEN-009 program uses ATLAS to identify patient neoantigens, or newly formed antigens unique to each patient, that are associated with that individual’s tumor. We are also exploring partnering opportunities in the development of cancer vaccines targeting tumor-associated antigens and a vaccine targeting cancers caused by Epstein-Barr Virus, or EBV.

We have one Phase 3-ready product candidate, GEN-003, an investigational immunotherapy for the treatment of genital herpes. In September 2017, we announced that we are exploring strategic alternatives to maximize value for GEN-003 through sale, partnership or other means. Consequently, substantially all GEN-003 spending and activities were ceased and we reduced our workforce by approximately 40 percent. We continue to believe that GEN-003 could address unmet medical needs of genital herpes patients.

ATLAS Platform

The importance of the T cell arm of the immune system is increasingly understood to be critical in the treatment of certain cancers. However, the discovery of effective T cell targets has been particularly challenging for two reasons. First, the diversity of human T cell responses means that an effective T cell target for one person may be different from an effective T cell target for another person. Second, the number of candidate targets for T cell responses can be very large with up to thousands of candidate antigens per patient in some cancers. These complexities represent fundamental barriers that traditional cancer vaccine target discovery tools, which rely largely on computer modeling - so-called predictive algorithms - have, as yet, only been poorly addressed.

We have designed the ATLAS platform to overcome these T cell target discovery challenges by identifying true neoantigens in an individual rather than using traditional predictive methods. We believe ATLAS represents the most comprehensive and accurate high throughput system for T cell vaccine and immunotherapy discovery in the biopharmaceutical industry. ATLAS is designed to mimic the T cell arm of the human immune system in a laboratory setting. Using ATLAS, we are able to measure T cell responses to the entire set of potential T cell targets for an individual’s cancer, allowing us to identify vaccine and immunotherapy targets associated with T cell responses which may kill an individual’s cancer.

We believe we are a leader in the field of T cell vaccine and immunotherapy discovery and development. Our management and scientific teams possess considerable experience in vaccine, immunotherapy and anti-infective

research, manufacturing, clinical development and regulatory matters.

Our Immuno-Oncology Program

We are focused on combining our antigen selection and vaccine development expertise to create new immuno-oncology treatments. Our potential cancer vaccines will be designed to educate T cells to recognize and attack specific targets and thereby kill cancer cells. We are working to develop personalized cancer vaccines by applying ATLAS to identify patient neoantigens that are associated with that individual's pre-existing immune responses to a tumor.

Neoantigens are personalized tumor mutations that are seen as "foreign" by an individual's immune system. Data published in recent years have indicated that an individual's response to neoantigens drives checkpoint inhibitor efficacy and that it is possible to vaccinate an individual against their own neoantigens. If approved, neoantigen vaccines could be used in

combination with existing treatment approaches for cancer, including immune checkpoint inhibitors, to potentially direct and enhance an individual's T cell response to the individual's cancer, thereby potentially affording better clinical outcomes.

Our lead immuno-oncology program, GEN-009, is an adjuvanted neoantigen peptide vaccine candidate designed to direct a patient's immune system to attack their tumor. GEN-009's neoantigens are identified by our proprietary ATLAS platform, which recalls a patient's pre-existing CD4+ and CD8+ cell immune responses to their tumor. Following ATLAS neoantigen identification, we will manufacture a personal vaccine for each patient.

We anticipate filing a personalized cancer vaccine IND application with the FDA in the first quarter of 2018 for GEN-009. We plan to initiate a Phase 1/2a clinical trial for GEN-009 in a range of tumor types in subjects with no evidence of disease but a high risk of relapse in mid-2018. We expect to report initial immunogenicity data from this trial in the first half of 2019.

We are also using ATLAS to develop cancer vaccines targeting tumor-associated, or shared, antigens and vaccines against cancers of viral origin. Our strategy in immuno-oncology combines our own internal neoantigen vaccine development programs with a focus on partnering ATLAS for these other immuno-oncology applications.

In November 2015, we commenced a program focused on EBV. EBV infection has been linked to cancers with high unmet needs such as non-Hodgkin's lymphoma, nasopharyngeal carcinoma and gastric carcinoma. We believe that ATLAS is highly suited to the creation of a new immunotherapy for EBV, given that T cell responses are understood to be crucial for protection against EBV. Furthermore, EBV is part of the herpes virus family, in which we have deep experience through our development of GEN-003. We are currently seeking a partner to advance the development of this vaccine.

We have had and continue to conduct a number of research collaborations which provide blood and tumor samples to support the development of ATLAS for application in neoantigen vaccines, shared antigen cancer vaccines and immune response profiling as follows:

- Neoantigen vaccine applications: Memorial Sloan Kettering Cancer Center (completed) and US Oncology Research (ongoing)
- Shared antigen cancer vaccines and immune response profiling: Dana-Farber Cancer Institute (completed) and Checkmate Pharmaceuticals (ongoing)

The Company is not dependent on these research collaborations to develop its product candidates and no material financial obligations exist as part of these collaborations.

Our Immuno-oncology Product Candidate Pipeline

The following table describes our active programs in development:

Vaccine Candidate	Program	Stage of Development	Next Milestone	Anticipated Timeline
GEN-009	Neoantigen cancer vaccine	Pre-clinical	File IND; commence Phase 1/2 clinical proof of concept trial	First quarter of 2018; mid-2018
GEN-010	Second generation neoantigen cancer vaccine	Pre-clinical	Select delivery technology platform	Ongoing
GEN-007	Epstein-Barr Virus	Research	Select antigen candidates	Ongoing, exploring partnering opportunities

GEN-006	Immuno-oncology -tumor associated antigen vaccine	Research	Select antigen candidates	Ongoing, exploring partnering opportunities

GEN-003 — Phase 2 immunotherapy for genital herpes, currently exploring strategic alternatives

Prior to our September 2017 strategic shift announcement, our lead program was GEN-003, a Phase 3-ready investigational immunotherapy for the treatment of genital herpes. We completed three positive clinical trials for which key data from those clinical trials is described below. We are currently exploring strategic alternatives to maximize shareholder value from GEN-003, during which time we have ceased substantially all activities under the GEN-003 program.

Phase 1/2 Trial

Final analysis of the data from the Phase 1/2a trial showed that, for the best performing 30µg dose group, there was a sustained reduction in the viral shedding rate. After completion of dosing for this group, the viral shedding rate showed a statistically significant reduction of 52% versus baseline and, at six months after the final dose, the shedding rate remained at 40% below baseline. The reduction in the genital lesion rate after completion of the third dose was greatest for the 30 µg dose group at 48%. After six months, the reduction from baseline in genital lesion rate for this dose group was 65% and, after 12 months, the genital lesion rate was 42% lower than baseline. GEN-003 was well tolerated over the 12 months of this clinical trial.

Phase 2 Dose Optimization Trial

A 310-subject Phase 2 dose optimization trial was completed in March 2016. The objective of this trial was to confirm the results of the Phase 1/2a trial and to test six combinations of proteins and adjuvant to determine the optimal dose for future trials and potentially improve on the profile of GEN-003. Subjects were randomized to one of six dosing groups of either 30µg or 60µg per protein paired with one of three adjuvant doses (25 µg, 50 µg, or 75 µg). A seventh group received placebo. Subjects received three doses of GEN-003 or placebo at 21-day intervals. Baseline viral shedding and genital lesion rates were established for each subject in a 28-day observation period prior to the commencement of dosing by collecting 56 genital swab samples (two per day), which were analyzed for the presence of HSV-2 DNA, and by recording the days on which genital lesions were present. This 28-day observation period was repeated immediately after the completion of dosing, and at six and twelve months following dosing. No maintenance doses were given. After the 28-day observation period immediately after dosing, patients in the placebo arm were rolled over across the six active dose combinations under a separate protocol. Subsequent to March 2016, we extended this clinical trial to include a separate protocol for an extension study which includes a 28-day observation period at 24 months post-dosing to evaluate the reduction versus baseline in both the viral shedding rate and the genital lesion rate.

The primary endpoint of the trial was the reduction in viral shedding rate versus baseline, a measure of anti-viral activity. A number of exploratory secondary endpoints were also studied, including, the reduction in genital lesion rates, the percent of patients who were recurrence free from lesions up to six and 12 months after dosing, and the time to first recurrence of lesions after dosing. We advanced the two most promising doses from this dose optimization study, the 60 µg per protein combined with either 50 or 75 µg of Matrix-M2 adjuvant ("60/50 Dose" and "60/75 Dose" respectively), into a Phase 2b efficacy trial for which positive twelve-month, placebo-controlled clinical efficacy data was announced in July 2017 (see Phase 2b trial below).

Phase 2b Trial

In December 2015, a Phase 2b clinical trial was initiated as our first study testing potential Phase 3 endpoints with a Phase 3-ready formulation of GEN-003, manufactured with commercially-scalable processes. The trial enrolled 131 subjects that were randomized to one of three dose groups - placebo, 60/50 Dose, and 60/75 Dose. All subjects received three injections at 21-day intervals.

In September 2016, we announced positive viral shedding rate reductions from the ongoing Phase 2b study. The study achieved its primary endpoint, with GEN-003 demonstrating a statistically significant (versus placebo and baseline) 40% reduction in the viral shedding rate compared to baseline immediately after dosing in the 60/50 Dose group, using a new Phase 3-ready formulation. This result was consistent with a statistically significant (versus placebo and baseline) viral shedding rate reduction of 41% at this same dose and time point in a prior Phase 2 clinical trial. In addition, the reactogenicity profile of this dose, an indication of the strength of the immune response to GEN-003, was consistent between the trials. This same dose in the prior Phase 2 clinical trial subsequently demonstrated virologic and clinical efficacy that was durable for at least one year after dosing.

The 60/75 Dose group reduced the viral shedding rate by 27%, which is lower than the rate observed in the prior trial, and also showed a less acceptable reactogenicity profile than the prior trial. We believe that the increase in reactogenicity of this dose indicates an overstimulation of the T cell immune system leading to the reduced efficacy with this dose in this trial, as would be expected with the known bell-shaped T cell dose response curve. The likely driver of this effect is a more potent adjuvant formulation following customary manufacturing process changes to prepare for Phase 3 clinical trials and commercialization of GEN-003.

In July 2017, we announced positive clinical results from the Phase 2b trial. At twelve months after dosing, GEN-003 demonstrated statistically significant improvements versus placebo in both the median genital lesion rate and across multiple clinical endpoints. The 60/50 Dose significantly reduced the median rate of genital lesions during the twelve months following

dosing compared to placebo (49% reduction versus placebo). The median genital lesion rate is an important overall measure of disease that captures both the frequency and duration of recurrences, both of which are important to both patients and their caregivers. Importantly, these results were achieved at the Phase 3 dose and expected Phase 3 primary endpoint. GEN-003 also consistently demonstrated significant benefits versus placebo across several other clinical endpoints across the dose groups.

GEN-003 demonstrated no grade 4 reactogenicity or related serious adverse events ("AEs") and discontinuations due to AEs were low and similarly distributed across active dose groups and placebo.
Around the end of the first quarter of 2017, we had a successful end-of-Phase 2 meeting with the U.S Food and Drug Administration ("FDA"). We believe that progress made and data generated to date in the GEN-003 preclinical and clinical trials remains valuable to the Company for the future.

Competition

The biotechnology and pharmaceutical industries are characterized by intense and rapidly changing competition to develop new technologies and proprietary products. Although we believe that our proprietary patent portfolio and T cell vaccine expertise provide us with competitive advantages, we face potential competition from many different sources, including larger and better-funded pharmaceutical companies. Not only must we compete with other vaccine companies but any products that we may commercialize will have to compete with existing therapies and new therapies that may become available in the future.

There are other organizations working to improve existing therapies or to develop new vaccines or therapies for our initially selected indications. Depending on how successful these efforts are, it is possible they may increase the barriers to adoption and success of our product candidates, including GEN-009, if approved.

There are several companies attempting to develop new neoantigen cancer vaccines, including Neon Therapeutics, Gritstone Oncology, Immatics Biotechnologies GmbH, Aduro, Advaxis, Agenus, Moderna, CureVac and BioNTech. We believe that GEN-009 has advantages against each of these product candidates based on the potential power of the ATLAS platform to comprehensively identify for each cancer patient the neoantigens to which such patient has a pre-existing immune response. We believe that selecting neoantigens for personal cancer vaccines using ATLAS will lead to more effective vaccines. However, there can be no assurance that one or more of these companies or other companies will not achieve similar or superior clinical results in the future as compared to GEN-009 or that our future clinical trials will be successful.
Many of our competitors, either alone or with their strategic partners, have substantially greater financial, technical and human resources than we do and significantly greater experience in the discovery and development of product candidates, obtaining FDA and other regulatory approvals of vaccines and the commercialization of those vaccines. Accordingly, our competitors may be more successful than us in obtaining approval for vaccines and achieving widespread market acceptance. Our competitors' vaccines may be more effective, or more effectively marketed and sold, than any vaccine we may commercialize and may render our vaccines obsolete or non-competitive.

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

We anticipate that we will face intense and increasing competition as new drugs enter the market and advanced technologies become available. We expect any vaccines that we develop and commercialize to compete on the basis

of, among other things, efficacy, safety, convenience of administration and delivery, price, the level of generic competition and the availability of reimbursement from government and other third-party payors.

Our commercial opportunity could be reduced or eliminated if our competitors develop and commercialize products 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 or other regulatory approval for their products more rapidly than we may obtain approval for our products, 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 payors seeking to encourage the use of generic products.
Intellectual Property

We strive to protect and enhance the proprietary technology, inventions and improvements that are commercially important to our business, including seeking, maintaining, and defending patent rights, whether developed internally or licensed from third parties. We also rely on trade secrets relating to our proprietary technology platform and on know-how, continuing technological innovation and in-licensing opportunities to develop, strengthen and maintain our proprietary position in the vaccine field. We additionally rely on regulatory protection afforded through data exclusivity, market exclusivity and patent term extensions where available. Still further, we utilize trademark protection for our company name, and expect to do so for products and/or services as they are marketed.

Our commercial success may depend in part on our ability to obtain and maintain patent and other proprietary protection for commercially important technology, inventions and know-how related to our business; defend and enforce our patents; preserve the confidentiality of our trade secrets; and operate without infringing the valid enforceable patents and proprietary rights of third parties. Our ability to stop third parties from making, using, selling, offering to sell or importing our products may depend on the extent to which we have rights under valid and enforceable patents or trade secrets that cover these activities. With respect to both licensed and company-owned intellectual property, we cannot be sure that patents will be granted with respect to any of our pending patent applications or with respect to any patent applications filed by us in the future, nor can we be sure that any of our existing patents or any patents that may be granted to us in the future will be commercially useful in protecting our commercial products and methods of manufacturing the same.

We have developed or in-licensed numerous patents and patent applications and possess substantial know-how and trade secrets relating to the development and commercialization of vaccine products. The term of individual patents depends upon the legal term of the patents in the countries in which they are obtained. In most countries in which we file, the patent term is 20 years from the date of filing the non-provisional application. In the United States, a patent’s term may be lengthened by patent term adjustment, which compensates a patentee for administrative delays by the United States Patent and Trademark Office ("U.S. PTO") in granting a patent, or may be shortened if a patent is terminally disclaimed over an earlier-filed patent.

The term of a patent that covers an FDA-approved drug may also be eligible for patent term extension, which permits patent term restoration of a United States patent as compensation for the patent term lost during the FDA regulatory review process. The Hatch-Waxman Act permits a patent term extension of up to five years beyond the expiration of the patent. The length of the patent term extension is related to the length of time the drug is under regulatory review. A patent term extension cannot extend the remaining term of a patent beyond a total of 14 years from the date of product approval and only one patent applicable to an approved drug may be extended. Moreover, a patent can only be extended once, and thus, if a single patent is applicable to multiple products, it can only be extended based on one product. Similar provisions are available in Europe and other foreign jurisdictions to extend the term of a patent that covers an approved drug. When possible, depending upon the length of clinical trials and other factors involved in the filing of a biologics license application ("BLA") we expect to apply for patent term extensions for patents covering our product candidates and their methods of use.

As of the date of this Annual Report on Form 10-K, our patent portfolio includes the following:

ATLAS

Our discovery platform patent portfolio includes four patent families, currently comprising seven issued U.S. patents. We hold an exclusive license from The Regents of the University of California ("UC") to the first patent family, including U.S. Patent 6,004,815 and the related U.S. Patents 6,287,556 and 6,599,502. This first family includes claims to fundamental aspects of the ATLAS platform, developed by our scientific founder, Darren Higgins, Ph.D. while he was employed at the University of California, Berkeley. Patents in this family have a patent term until

August 2018. We hold a further exclusive license from President and Fellows of Harvard College ("Harvard") to the second patent family, which covers methods related to the ATLAS discovery platform, including discovery of antigens expressed in neoplastic cells. This second patent family includes U.S. Patent 9,051,564, a pending and allowed U.S. application, issued patents in Europe and Australia and pending applications in Europe and Canada. Patents issuing from these applications are expected to expire in 2027 with the exception of U.S. Patent 9,051,564 which includes a Patent Term Adjustment and extends until December 2031. We wholly own the third patent family, which is specifically directed to the ATLAS platform as utilized by us, including for discovery of cancer-or tumor-related antigens. This third patent family includes U.S. Patents 8,313,894, 9,045,791, and 9,873,370, a pending and U.S. patent application, an issued patent in Australia, an allowed application in Canada, and pending applications in Europe, Canada and Australia. Patents issuing from applications in this family are expected to have a patent term until at least July 2029. U.S. Patents 8,313,894 and 9,045,791 have terms that include Patent Term Adjustments and extend until August 2030 and August 2029, respectively. U.S. Patent 9,873,870 has a term that extends until July 2029. We wholly own the fourth patent family, which is directed to methods for cancer diagnosis, prognosis, and patient selection, as well as related compositions. This fourth family currently comprises three provisional applications.

GEN-003 (Genital Herpes)

We wholly own a portfolio of patent applications directed to HSV-2 vaccines, including GEN-003. This portfolio includes three patent families covering HSV-2 vaccine compositions and methods for inhibiting or treating HSV-2 infections, combination treatment with antiviral medications, and maintenance dosing. The first patent family includes U.S. Patent 8,617,564, a pending and allowed U.S. application, and patents granted in Australia, China, Indonesia, Israel, Japan, Korea, Mexico, Malaysia, New Zealand, Russia, Singapore, and South Africa. Applications in Europe, Canada, Brazil, India, China and Hong Kong are pending in the first patent family. Patents that issue from applications in the first family are expected to expire in 2030. The term for U.S. Patent 8,617,564 includes Patent Term Adjustment and extends until at least November 2030. The second family includes a pending PCT application and a pending U.S. application. The third family comprises one provisional application. Patents that issue from applications in these families are expected to expire in 2037 and 2038, respectively.

We own two further patent families covering follow-on HSV-2 vaccine compositions. The first family includes U.S. Patent 9,782,474 and patents issued in Australia and Japan. The second family includes U.S. Patent 9,624,273, patents granted in Australia and Japan, and pending applications in Europe and Canada. Patents that issue from applications in these families are expected to expire in 2031 and 2032, respectively.

We hold a license from Isconova AB (now Novavax, Inc.) to two patent families covering Matrix-M2, the adjuvant used in GEN-003. The first patent family includes a pending U.S. application and issued patents in Europe, Canada, Australia, Japan, Brazil, New Zealand and South Africa. The second patent family includes U.S. Patent 8,821,881 and issued patents in Europe, Canada, Australia, Japan, Brazil, New Zealand and South Africa. These issued patents have patent terms until at least July 2023 and July 2024. The issued U.S. patent in the second patent family, U.S. Patent 8,821,881, has a term that extends until August 2026 inclusive of a Patent Term Adjustment.

In addition to the above, we have established expertise and development capabilities focused in the areas of preclinical research and development, manufacturing and manufacturing process scale-up, quality control, quality assurance, regulatory affairs and clinical trial design and implementation. We believe that our focus and expertise will help us develop products based on our proprietary intellectual property.

In-License Agreements

University of California

In August 2006, we entered into an exclusive license agreement with UC granting us an exclusive, royalty-bearing sublicensable license to a patent family that includes claims to fundamental aspects of the ATLAS platform, to make, use, offer for sale, import and sell licensed products and services, and to practice licensed methods in all fields of use in the United States. This patent family consists entirely of issued United States patents with a patent term until August 2018. UC retains the right to practice and to allow other educational and non-profit institutions to practice, the licensed intellectual property licensed under the agreement for educational and research purposes.

Until first commercial sale of a licensed product or service, we are obligated to pay UC an annual license maintenance fee in the low five figures. Upon commercialization of our products and services covered by the licensed patents, we are obligated to pay UC royalties in the low single digits, subject to a minimum annual royalty in the low five figures, on the net sales of such products and services sold by us or our affiliates for the life of any licensed patents covering the products or services. The royalties payable to UC are subject to reduction for any third party payments required to be made, with a minimum floor in the low single digits. In addition, we agreed to pay UC a flat royalty in the low single digits on net sales of products sold by us or our affiliates which include a polypeptide, nucleotide sequence,

biological organism or chemical entity identified in the practice of a licensed method or service, but not otherwise covered, by the licensed patent for the life of the licensed patents. If we receive any revenue (cash or non-cash) from any sublicensees, we must pay UC a percentage of such revenue, excluding certain categories of payments but including royalties on net sales by sublicensees, varying in the low-double digits for any sublicense depending on the scope of the license. Under the terms of the agreement, we are obligated to pay UC a specified development milestone payment and a specified commercial milestone payment up to $500 thousand in the aggregate for the first licensed product covered by the licensed patents, plus up to an additional $250 thousand if specified development and commercial milestones are met for each subsequent licensed product covered by the licensed patents. As of December 31, 2017, we have not made any milestone payments.

We are required to diligently develop and market licensed products, services and methods. If we are unable to meet our diligence obligations, even after any extension thereof, UC has the right, depending on the number of years the agreement has been effective, to either terminate the agreement or convert our exclusive license to a non-exclusive license.

Unless earlier terminated, the agreement with UC will remain in effect until the expiration of the last-to-expire patent under the licensed patent rights in August 2018. We may terminate the agreement at any time by giving UC advance written notice. The agreement may also be terminated by UC in the event of a material breach by us that remains uncured after a specified period of time.

Harvard University

In November 2007, we entered into an exclusive license agreement with Harvard, granting us an exclusive, worldwide, royalty-bearing, sublicensable license to three patent families, to develop, make, have made, use, market, offer for sale, sell, have sold and import licensed products and to perform licensed services. This agreement was amended and restated in November 2012. The Harvard intellectual property covers methods related to the ATLAS discovery platform, including discovery of antigens expressed in neoplastic cells, as well as certain chlamydia immunogenic compositions and methods for inhibiting or treating chlamydia infections. Any patents within this portfolio that have issued or may be issued will expire normally in 2027 and 2028. Harvard retains the right to make and use, and to grant licenses to other not-for-profit research organizations to make and use, the licensed intellectual property for internal research, teaching and other educational purposes. We notified Harvard of our partial termination of the license agreement with regard to intellectual property covering chlamydia antigens on December 8, 2014. Effective March 8, 2015, the license agreement with Harvard with regard to intellectual property covering chlamydia antigens was terminated and we no longer hold a license to two of the three in-licensed Harvard patent families, or to a chlamydia antigen covered by the remaining family. The remaining family covers certain aspects of the ATLAS platform, as well as one chlamydia antigen, and we continue to maintain exclusive rights to aspects of the ATLAS platform covered by this family.

We are obligated to pay Harvard an annual license maintenance fee ranging from the low five figures to the mid-five figures depending on the type of product and the number of years after the effective date of the agreement. For products covered by the licensed patent rights, we are obligated to pay Harvard milestone payments up to $1.8 million in the aggregate upon the achievement of certain development and regulatory milestones. For products discovered using the licensed methods, we are obligated to pay Harvard milestone payments up to $600 thousand in the aggregate for each of the first three products and up to $300 thousand in the aggregate for each additional product under the agreement upon the achievement of certain development and regulatory milestones. As of December 31, 2017, we paid $198 thousand in aggregate milestone payments. Upon commercialization of our products covered by the licensed patent rights or discovered using the licensed methods, we are obligated to pay Harvard royalties on the net sales of such products and services sold by us, our affiliates and our sublicensees. This royalty varies depending on the type of product or service but is in the low single digits. The royalty based on sales by our sublicensees is the greater of the applicable royalty rate or a percentage in the high single digits or the low double digits of the royalties we receive from such sublicensee depending on the type of product. Depending on the type of commercialized product or service, royalties are payable until the expiration of the last-to-expire valid claim under the licensed patent rights or for a period of 10 years from first commercial sale of such product or service. The royalties payable to Harvard are subject to reduction, capped at a specified percentage, for any third party payments required to be made. In addition to the royalty payments, if we receive any additional revenue (cash or non-cash) under any sublicense, we must pay Harvard a percentage of such revenue, excluding certain categories of payments, varying from the low single digits to up to the low double digits depending on the scope of the license that includes the sublicense.

We are required to use commercially reasonable efforts to develop licensed products, introduce them into the commercial market and market them, in compliance with an agreed upon development plan. We are also obligated to achieve specified development milestones. If we are unable to meet our development milestones for any type of product or service, absent any reasonable proposed extension or amendment thereof, Harvard has the right, depending on the type of product or service, to terminate this agreement with respect to such products or to convert the license to a non-exclusive, non-sublicensable license with respect to such products and services.

Our agreement with Harvard will expire on a product-by-product or service-by-service and country-by-country basis until the expiration of the last-to-expire valid claim under the licensed patent rights. We may terminate the agreement at any time by giving Harvard advance written notice. Harvard may also terminate the agreement in the event of a material breach by us that remains uncured; in the event of our insolvency, bankruptcy, or similar circumstances; or if we challenge the validity of any patents licensed to us.

Other Collaborations

Novavax

In August 2009, we entered into an exclusive license and collaboration agreement with Isconova AB, a Swedish company which has subsequently been acquired by Novavax. The agreement grants us a worldwide, sublicensable, exclusive license to two patent families, to import, make, have made, use, sell, offer for sale and otherwise exploit licensed vaccine products containing an adjuvant which incorporates or is developed from Matrix-A, Matrix-C and/or Matrix-M technology, in the fields of HSV and chlamydia, and the time-limited exclusive fields of Neisseria gonorrhoeae, cytomegalovirus and Mycobacterium tuberculosis. In July 2015, upon expiration of the five-year exclusivity term included in the agreement, the license granted to us converted to a non-exclusive license with respect to all licensed intellectual property rights that were not jointly invented by us and Novavax under the collaboration. Under the terms of this agreement, Novavax also grants us a worldwide, sublicensable, non-exclusive license under such licensed intellectual property rights to import, make, have made, use, sell, offer for sale and otherwise exploit licensed products in the field of Streptococcus pneumoniae. Our rights in the field of Streptococcus pneumoniae are exclusive with respect to all intellectual property rights jointly invented by us and Novavax under the collaboration. The agreement further grants us certain limited rights to use Novavax trademarks.

For licensed products in each unique disease field under the agreement, we are obligated to pay Novavax milestone payments up to approximately $3.0 million in the aggregate upon the achievement of certain development and commercial milestones. As of December 31, 2017, we paid $275 thousand in aggregate milestone payments. Upon commercialization of our products, we are obligated to pay Novavax royalties on the net sales of licensed products sold by us, our affiliates and our sublicensees. The royalties payable to Novavax are in the low single digits and vary on a country-by-country and licensed product-by-licensed product basis based on the amount of net sales and the nature and timing of the licensed product’s development. The royalties payable to Novavax are subject to reduction if the licensed product is not covered by one or more valid claims of the licensed patent righ