

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, 2020

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 001-39103

CABALETTA BIO, INC.

(Exact name of Registrant as specified in its Charter)

Delaware
(State or other jurisdiction of
incorporation or organization)
2929 Arch Street, Suite 600
Philadelphia, PA
(Address of principal executive offices)

82-1685768
(I.R.S. Employer
Identification No.)

19104
(Zip Code)

Registrant's telephone number, including area code: (267) 759-3100

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

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common Stock, par value \$0.00001 per share	CABA	The Nasdaq Global Select 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 Section 15(d) of the Act. Yes No

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

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

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

Large accelerated filer	<input type="checkbox"/>	Accelerated filer	<input type="checkbox"/>
Non-accelerated filer	<input checked="" type="checkbox"/>	Smaller reporting company	<input checked="" type="checkbox"/>
		Emerging growth company	<input checked="" type="checkbox"/>

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

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

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

As of June 30, 2020 (the last business day of the registrant's most recently completed second fiscal quarter), the aggregate market value of the registrant's common stock held by non-affiliates was approximately \$214 million based on the last reported sale price of the registrant's common stock on the Nasdaq Global Select Market on June 30, 2020.

The number of shares of registrant's Common Stock outstanding as of March 10, 2021 was 24,062,775.

DOCUMENTS INCORPORATED BY REFERENCE

Part III of this Annual Report on Form 10-K incorporates by reference certain information from the registrant's definitive Proxy Statement for its 2021 annual meeting of shareholders, which the registrant intends to file pursuant to Regulation 14A with the Securities and Exchange Commission not later than 120 days after the registrant's fiscal year end of December 31, 2020. Except with respect to information specifically incorporated by reference in this Form 10-K, the Proxy Statement is not deemed to be filed as part of this Form 10-K.

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Summary of the Material and Other Risks Associated with Our Business

- We are a clinical-stage company with a limited operating history, have incurred significant losses since our inception, and anticipate that we will continue to incur significant losses for the foreseeable future.
- We are highly dependent on our relationship with University of Pennsylvania, or Penn, for our preclinical research and development activities, key technology and our current manufacturing needs for our clinical trial of DSG3-CAART, or the DesCAARTes™ trial, and if Penn's manufacturing capacity is reduced or otherwise delayed or limited, this could adversely impact enrollment in our DesCAARTes™ trial.
- We are reliant on intellectual property licensed to us by Penn and termination of our license agreement with Penn would result in the loss of significant rights, which would have a material adverse effect on our business.
- If we are unable to obtain and maintain sufficient intellectual property protection for DSG3-CAART, our other product candidates and technologies or any future product candidates, we may not be able to compete effectively in our markets.
- We will need to raise substantial additional funding before we can expect to complete development of any of our product candidates or generate any revenues from product sales.
- Our limited operating history may make it difficult for you to evaluate the success of our business to date and to assess our future viability.
- If we are unable to successfully develop our current programs into a portfolio of product candidates, or experience significant delays in doing so, we may not realize the full commercial potential of our current and future product candidates.
- If we encounter difficulties enrolling patients in our DesCAARTes™ trial or future clinical trials, these clinical development activities could be delayed or otherwise adversely affected.
- If we are unable to advance our product candidates through clinical development, obtain regulatory approval and ultimately commercialize our product candidates, or experience significant delays in doing so, our business will be materially harmed.
- Results of earlier studies may not be predictive of future study or trial results, and we may fail to establish an adequate safety and efficacy profile to conduct clinical trials or obtain regulatory approval for our product candidates.
- If serious adverse events, undesirable side effects or unexpected characteristics are identified during the development of any of our product candidates, we may need to delay, abandon or limit our further clinical development of those product candidates.
- The COVID-19 pandemic and the future outbreak of other highly infectious or contagious diseases could seriously harm our research, development and potential future commercialization efforts, increase our costs and expenses and have a material adverse effect on our business, financial condition and results of operations.
- Manufacturing and administering our product candidates is complex and we may encounter difficulties in technology transfer from Penn to a contract manufacturing organization.
- We face substantial competition, which may result in others discovering, developing or commercializing products before or more successfully than we do.
- We may establish our own manufacturing facility and infrastructure in addition to or in lieu of relying on third parties for the manufacture of our product candidates, which will be costly and time-consuming, and which may not be successful.
- Our future success depends in part upon our ability to retain our key employees, consultants and advisors and to attract, retain and motivate other qualified personnel.

SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K, including the sections entitled “Risk Factors” and “Management’s Discussion and Analysis of Financial Condition and Results of Operations,” contains express or implied forward-looking statements that are based on our management’s belief and assumptions and on information currently available to our management. Although we believe that the expectations reflected in these forward-looking statements are reasonable, these statements relate to future events or our future operational or financial performance, and involve known and unknown risks, uncertainties and other factors that may cause our actual results, performance or achievements to be materially different from any future results, performance or achievements expressed or implied by these forward-looking statements. Forward-looking statements in this Annual Report on Form 10-K include, but are not limited to, statements about:

- the success, cost and timing and conduct of our clinical trial program, including our clinical trial of DSG3-CAART, or the DesCAARTeTM trial, and our other product candidates, including statements regarding the timing of initiation and completion of the clinical trials and the period during which the results of the clinical trials will become available;
- the timing of and our ability to obtain and maintain regulatory approval of our product candidates, including DSG3-CAART, MuSK-CAART, FVIII-CAART and DSG3/1-CAART, in any of the indications for which we plan to develop them, and any related restrictions, limitations, and/or warnings in the label of an approved product candidate;
- the impact of any business interruptions to our operations, including the timing and enrollment of patients in our ongoing and planned clinical trials and our planned Investigational New Drug application submissions, or to those of our clinical sites, manufacturers, suppliers, or other vendors resulting from the coronavirus disease (COVID-19) pandemic or similar public health crisis;
- our expected use of proceeds from the initial public offering and the period over which such proceeds, together with cash, will be sufficient to meet our operating needs;
- our plans to pursue research and development of other product candidates;
- our plan to infuse our DSG3-CAART product candidate without lymphodepletion or other preconditioning agents initially in our DesCAARTeTM trial;
- the potential advantages of our proprietary Cabaletta Approach for selective B cell Ablation platform, called our CABA platform, and our product candidates;
- the extent to which our scientific approach and CABA platform may potentially address a broad range of diseases;
- the potential benefits and success of our arrangements and our expanded sponsored research agreement with the Trustees of the University of Pennsylvania, or Penn, and the Children’s Hospital of Philadelphia, or CHOP, and our scientific co-founders, Drs. Milone and Payne;
- our ability to successfully commercialize our product candidates, including DSG3-CAART and our other product candidates;
- the potential receipt of revenue from future sales of DSG3-CAART and our other product candidates;
- the rate and degree of market acceptance and clinical utility of DSG3-CAART and our other product candidates;
- our estimates regarding the potential market opportunity for DSG3-CAART and our other product candidates, and our ability to serve those markets;
- our sales, marketing and distribution capabilities and strategy, whether alone or with potential future collaborators;
- our ability to establish and maintain arrangements or a facility for manufacture of DSG3-CAART and our other product candidates;
- our ability to obtain funding for our operations, including funding necessary to initiate and complete our DesCAARTeTM trial and our ongoing preclinical studies of MuSK-CAART, DSG3/1-CAART and FVIII-CAART;
- the potential achievement of milestones and receipt of payments under our collaborations;
- our ability to enter into additional collaborations with existing collaborators or other third parties;
- our expectations regarding our ability to obtain and maintain intellectual property protection for our product candidates and our ability to operate our business without infringing on the intellectual property rights of others;
- the success of competing therapies that are or become available, and our competitive position;
- the accuracy of our estimates regarding expenses, future revenues, capital requirements and needs for additional financing;
- the impact of government laws and regulations in the United States and foreign countries; and
- our ability to attract and retain key scientific or management personnel.

These factors should not be construed as exhaustive and should be read in conjunction with the other cautionary statements that are included in this Annual Report on Form 10-K. The forward-looking statements contained in this Annual Report on Form 10-K are made as of the date of this Annual Report on Form 10-K, and we undertake no obligations to publicly update or review any forward-looking statement, whether as a result of new information, future developments or otherwise.

PART I

Item 1. Business.

Overview

We are a clinical-stage biotechnology company focused on the discovery and development of engineered T cell therapies, and exploring their potential to provide a deep and durable, perhaps curative, treatment, for patients with B cell-mediated autoimmune diseases. Our proprietary technology utilizes Chimeric AutoAntibody Receptor, or CAAR, T cells that are designed to selectively bind and eliminate only specific B cells that produce disease-causing autoantibodies, or pathogenic B cells, while sparing normal B cells. Our lead CAAR T cell product candidate was designed based on the clinically validated and commercially approved Chimeric Antigen Receptor, or CAR, T cell technology that is marketed for the treatment of B cell cancers. By harnessing the power of targeted cell therapy, we believe our CAAR T product candidates have the potential to provide responses that may be a safer and more effective option than current treatments. We believe our technology, in combination with our proprietary Cabaletta Approach for selective B cell Ablation platform, called our CABA platform, has applicability across over two dozen B cell-mediated autoimmune diseases that we have identified, evaluated and prioritized. Our initial focus is mucosal pemphigus vulgaris, or mPV, which is an autoimmune blistering disease. Our lead product candidate, DSG3-CAART, designed to treat patients with mPV, is currently enrolling patients for a Phase 1 trial, or the DesCAARTes™ trial. We expect to report the acute safety data from the first cohort of patients in the DesCAARTes™ trial in the first half of 2021, with additional topline data on any completed dose cohorts throughout the second half of 2021. Our lead preclinical product candidate, designed for the treatment of muscle-specific kinase myasthenia gravis, or MuSK MG, is currently in Investigational New Drug, or IND, enabling studies with an IND submission expected in the second half of 2021. We are also advancing additional product candidates currently in discovery-stage or preclinical development for the treatment of mucocutaneous PV, or mcPV, and Hemophilia A with Factor VIII, or FVIII, alloantibodies in addition to three undisclosed targets.

B cell-mediated autoimmune diseases occur when certain populations of B cells mistakenly produce autoantibodies, which are directed against specific healthy tissue or cells in the body. The presence of autoantibodies can manifest in a variety of autoimmune diseases and result in the destruction of healthy tissue in the body. Current treatment options for B cell-mediated autoimmune diseases are generally limited to corticosteroids and other generalized immunosuppressants that offer only temporary disease suppression, may require chronic, in-hospital administration and are associated with potentially life-threatening side effects. We believe the ideal therapy for B cell-mediated autoimmune diseases would selectively and completely eliminate the pathogenic B cells while sparing the body's normal B cells.

We are pioneering the development of a new class of engineered T cell therapies that express CAARs to selectively engage and eliminate pathogenic B cells. Our CAARs build upon the scientific foundation of CARs, differing primarily in the use of the antigen rather than an antibody fragment, which enables the CAAR T cells to serve as a “decoy” for specific autoantibodies expressed on the surface of B cells. This allows these pathogenic B cells to engage with the CAAR T cells instead of benign antigens, resulting in their elimination. We have developed our CABA platform to inform product candidate development from scientific, clinical and commercial assessment through CAAR design. Using our CABA platform, we have identified and thoroughly evaluated over two dozen B cell-mediated autoimmune diseases that we believe will be amenable to treatment with the Cabaletta approach and have advanced several of our highest priority targets into discovery and preclinical testing.

Our current product candidate pipeline is illustrated below.

Indication	Program	Discovery*	Preclinical	Phase 1	Phase 2	Phase 3**
Mucosal Pemphigus Vulgaris	DSG3-CAART	[Progress bar spanning Discovery, Preclinical, and Phase 1]				
Mucocutaneous Pemphigus Vulgaris	DSG3/1-CAART	[Progress bar in Discovery]				
MuSK Myasthenia Gravis	MuSK-CAART	[Progress bar spanning Discovery and Preclinical]				
Hemophilia A w/ FVIII Alloantibodies	FVIII-CAART	[Progress bar in Discovery]				

* In our discovery stage, we perform epitope mapping and optimize CAAR construct and design.

** May not be required if Phase 2 is a registrational clinical trial, subject to discussion with the FDA.

Our initial therapeutic focus is on pemphigus vulgaris, or PV, a chronic, autoimmune blistering skin disease. Despite a current standard of care that includes corticosteroids and adjunctive immunosuppressive agents, PV remains associated with frequent recurrences as well as substantial morbidity and mortality. Our lead product candidate, DSG3-CAART, is being evaluated for the treatment of mPV, a subtype of PV that affects mucosal surfaces. mPV is caused by autoantibodies against the cell adhesion protein desmoglein 3, or DSG3. DSG3-CAART is designed to selectively target B cells expressing autoantibodies specific for DSG3, which may prevent these B cells from producing DSG3 antibodies that are the cause of mPV while preserving general B cell immune function. In January 2020, the U.S. Food and Drug Administration, or the FDA, granted orphan drug designation to DSG3-CAART for the treatment of PV. In May 2020, DSG3-CAART received fast track designation from the FDA for improving healing of mucosal blisters in patients with mPV. In December 2020, we announced that the first patient had been dosed in the DesCAARTes™ trial. Our next PV-directed product candidate, DSG3/1-CAART, is being designed to target B cells expressing autoantibodies against DSG3 and desmoglein 1, or DSG1. It is being developed for the treatment of mucocutaneous PV, or mcPV, another subtype of PV that affects both mucosal and skin surfaces and is caused by autoantibodies against DSG3 and DSG1, respectively.

Our lead preclinical product candidate, MuSK-CAART, is designed to treat a subset of patients with myasthenia gravis, or MG. MG is an autoimmune disease induced by autoantibodies targeting the neuromuscular junction, or NMJ, which can lead to life-threatening muscle weakness. Our product candidate targets B cells expressing autoantibodies against a transmembrane protein, muscle-specific kinase, or MuSK, and is being developed for the treatment of MuSK MG. Data from our initial *in vitro* and *in vivo* studies of MuSK-CAART was presented at the American Academy of Neurology’s Science Highlights Virtual Platform in May 2020. The efficacy and safety of MuSK CAAR T cells were investigated using *in vitro* cytotoxicity assays, *in vitro* screens for off-target toxicity and a mouse model to evaluate the efficacy of human MuSK CAAR T cells against MuSK antibody expressing B cells *in vivo*. In preclinical studies, MuSK CAAR T cells demonstrated *in vitro* cytotoxicity towards a B cell line expressing anti-MuSK antibodies, but we did not observe any cytotoxicity when the anti-MuSK antibody was not expressed. In addition, MuSK CAAR T cells also targeted and eliminated a panel of B cells targeting different MuSK epitopes. In an *in vivo* mouse model, MuSK CAAR T cells, but not control CAAR T cells, showed biological activity by blocking the growth of B cell lines expressing an anti-MuSK antibody. Based in part on these results, IND-enabling studies have been initiated and an IND submission is anticipated in the second half of 2021.

We are also pursuing development of an additional product candidate, FVIII-CAART, which is being designed to treat a subset of patients with Hemophilia A, an X-linked bleeding disorder caused by mutations in the FVIII gene. While our CABA platform is primarily focused on the treatment of B cell-mediated autoimmune diseases, we believe our approach may be applicable in other instances where B cell antibody production is

implicated in response to exogenous FVIII, which is administered for the treatment of Hemophilia A. Specifically, we have identified an unmet need in cases where the immune system produces antibodies against exogenous antigens, which is known as an alloimmune response. Some patients receiving repeated administrations of exogenous FVIII will develop alloantibodies against the treatment, also known as inhibitors, neutralizing its therapeutic potential. Patients with FVIII alloantibodies may often require high-dose FVIII, immune tolerance induction with FVIII, agents that mimic FVIII or plasmapheresis to remove the FVIII alloantibodies. FVIII-CAART leverages a CAAR designed to target B cells expressing alloantibodies against FVIII, and it is initially being developed as an adjunctive therapy for Hemophilia A patients who develop FVIII alloantibodies.

Our manufacturing strategy is a three-stage process designed to initially leverage the extensive early-stage manufacturing expertise of our academic partners while migrating to contract manufacturing organization, or CMO, partnerships and ultimately aiming to achieve full manufacturing independence. We believe partnering with proven and reputable manufacturing partners has allowed us to efficiently deploy financial and personnel resources. Stage 1 leverages the expertise in cell and vector manufacturing of our partners at the Children's Hospital of Philadelphia, or CHOP, and the University of Pennsylvania, or Penn. This stage included early development work, support of the DSG3-CAART IND, and cell and vector product manufacturing for our DesCAARTes™ trial. We believe these partnerships and use of these established facilities have allowed us to move efficiently into clinical trials, but are not sufficient to support a commercial license. Stage 2, which is ongoing, is designed to engage partners who are qualified for manufacturing of vectors at commercial grade and scale and who have experience with cell processing. In January 2021, we initiated a collaboration with WuXi Advanced Therapies, Inc. or WuXi, to serve as our cell processing manufacturing partner for the anticipated MuSK-CAART Phase 1 clinical trial. Contingent on sufficient clinical evidence from the DesCAARTes™ trial, we plan to advance the third stage of our manufacturing strategy which will include building, qualifying and operating our own manufacturing facility. We believe this additional stage will enable full control of product development and commercial supply for products arising from our CABA platform, enabling us to achieve continuous improvement of our product candidates. Our Chief Executive Officer and Executive Vice President, Science and Technology, have both, in prior roles, built and led organizations that have constructed and commissioned cell therapy facilities which we hope will enable us to smoothly transition to stage 3 when feasible.

We plan to build upon our first mover advantage in the field of targeted cell therapy for B cell-mediated autoimmune diseases and further advance the discovery, development and commercialization of our CAAR T portfolio. Our extensive correlative study program has been designed to inform clinical observations from the DesCAARTes™ trial in order to preserve and expand our industry leading insights into the impact of CAAR T therapies in patients. Our scientific founders are leading experts in B cell-mediated autoimmune diseases and CAR T technology, and we are led by an experienced team with demonstrated success in discovering, developing, manufacturing, and evaluating novel cell therapy products in clinical trials. In addition, we have partnered our discovery and initial development efforts with Penn, a pioneer in cell and gene therapy with a proven track record of expertise in the translational research, clinical development and manufacturing of cell therapy products, in order to advance our lead product candidate in clinical trials along with our preclinical product candidates.

Our History and Team

Our scientific co-founders, Aimee Payne, M.D., Ph.D., and Michael Milone, M.D., Ph.D., began partnering at Penn in 2013 to combine Dr. Payne's expertise in B cell-mediated autoimmune diseases with Dr. Milone's deep and experienced insights into the design and implementation of CAR T products. Dr. Payne is a worldwide leader in characterizing B cell-mediated autoantibody repertoires in PV and other autoimmune diseases. Dr. Milone is a renowned scientist in CAR T therapy and was a co-inventor of and a key driver in the preclinical discovery and development efforts that yielded Kymriah, the first FDA-approved CAR T therapy for the treatment of B cell cancers. Dr. Payne's laboratory surmised that by incorporating an antigen instead of an antibody fragment as the extracellular domain of the CAAR, specific pathogenic B cells could be targeted. This resulted in a collaboration between the two investigators to apply the scientific foundation of CAR T technology as it has been advanced by Drs. Payne and Milone in order to address B cell-mediated autoimmune diseases.

Their first scientific publication, "Reengineering chimeric antigen receptor T cells for targeted therapy of autoimmune disease" (*Science*, July 2016), attracted the attention of a colleague, Steven Nichtberger, M.D., who is an adjunct professor at the Wharton School at the University of Pennsylvania, teaching a class on biotech company

formation, financing and leadership in the Vagelos Life Sciences & Management Program. Additionally, Dr. Nichtberger has experience creating and building companies, including a novel cellular therapy company, which required transferring the technology from an academic institution, establishing a research and development organization, hiring of manufacturing and quality teams, creating novel manufacturing processes, reaching agreement with the FDA on novel clinical development pathways and constructing a commercial-scale Good Manufacturing Practices, or GMP, facility that manufactured autologous cell therapy products for clinical trials. In 2017, based on over a year of interaction and discussions regarding the optimal strategy to advance the scientific opportunity into a commercially developed product portfolio that could offer potentially curative treatment options to patients, Drs. Payne, Milone and Nichtberger decided to launch Cabaletta Bio.

The longstanding and highly productive partnership between our co-founders has been complemented by additional management experience that brings a successful history of translating academic cellular therapy research from Penn and elsewhere into commercially sponsored clinical trials and the establishment of a GMP manufacturing facility and organization. Gwendolyn Binder, Ph.D., our Executive Vice President, Science and Technology, was an early member of the Translational Research Program Operations team at Penn for over five years and participated in the submission and acceptance of multiple INDs for novel engineered T cell therapy products. As part of the cell therapy organization at Penn, Dr. Binder partnered with Dr. Milone and others to drive the IND-enabling translational studies that facilitated the initial CAR T clinical trial in B cell cancers at Penn. Dr. Binder also built and led a clinical stage biotechnology company's manufacturing operations and quality teams, including creation of a fully functioning commercial grade GMP facility. Dr. Binder also built the translational research program and ultimately led the company's research organization.

Our Research and Manufacturing Collaboration with Penn

Our CABA platform has already produced multiple product candidates through our sponsored research agreements, or SRAs, with Penn for the laboratories of our scientific co-founders, Drs. Payne and Milone. Our continuing relationship with our scientific co-founders provides important guidance and insights to us. Our contractual relationship with Penn through ongoing licensing and research arrangements also provides important services around manufacturing supply.

In May 2020, we amended and restated our worldwide license agreement with Penn to develop our CAAR T technology to treat B cell-mediated autoimmune and alloimmune diseases. This license agreement provides us with access to multiple patent families covering CAAR T therapy as applied to the field of B cell-mediated autoimmune and alloimmune diseases and to the robust intellectual property portfolio created by Penn under these SRAs in this field. See “—Our Material Agreements—Amended and Restated License Agreement with Penn.”

Our ongoing collaboration with Penn is also based on a Master Translational Research Services Agreement, or the Services Agreement, that we entered into in October 2018, along with multiple additional agreements under the Services Agreement to engage and partner in individual Penn entities, including cell product manufacturing, correlative research, vector manufacturing, clinical trial operations and protocol development. In addition to the Services Agreement, we have agreements in place with various functional areas and centers that provide additional resources to Penn as well as contractual commitments from Penn with the goal of providing the capacity to manufacture our lead product candidate, DSG3-CAART. Penn has also agreed to manufacture vector product for use in our clinical trials. Penn's obligations are subject to certain limitations and termination rights. See “—Our Material Agreements—Master Translational Research Services Agreement with Penn”.

We believe Penn is uniquely suited to be our partner in our efforts to develop product candidates leveraging our CAAR T technology based on a decade of experience, including manufacturing and clinical support for approximately a dozen active cell therapy clinical trials. The original manufacturing process for the first FDA-approved CAR T therapy was developed at Penn before being transferred to Novartis Pharmaceuticals Corporation during late-stage clinical trials. We are leveraging Penn's experience, validated standard operating procedures, manufacturing facilities and staffing to accelerate development efforts for our lead product candidate.

Our Strategy

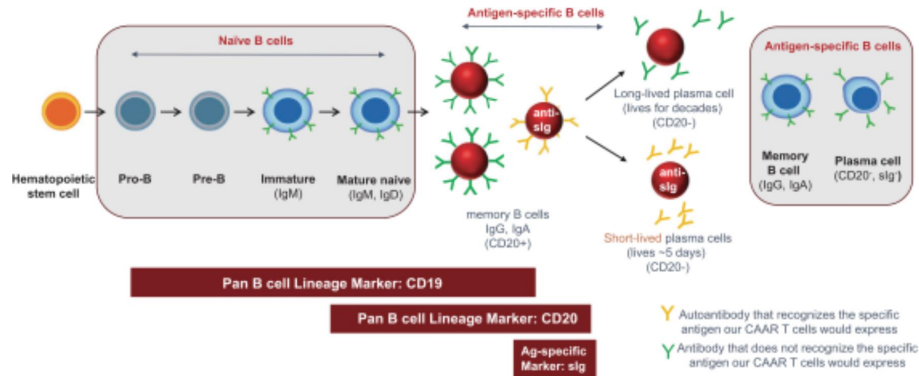
Our goal is to build upon our first mover advantage and expertise in cell therapies for B cell-mediated autoimmune diseases to accelerate the discovery, development and commercialization of our CAAR T cell therapies, with a focus on reliable manufacturing. We believe achieving this goal could result in potentially curative therapies for patients with unmet medical needs who suffer from certain B cell-mediated autoimmune diseases. To achieve this goal, key elements of our strategy include:

- ***Achieving clinical proof-of-concept for our lead product candidate, DSG3-CAART in mPV, the first in a series of well-understood and validated B cell-mediated autoimmune diseases for which we are developing CAAR T cell product candidates.*** It is well-established that the presence of DSG3 autoantibodies and DSG3 autoantibody producing B cells in patients are both necessary and sufficient to cause mPV in the vast majority of cases. We believe our biologic understanding coupled with the well-understood clinical signs, symptoms and natural course of the disease, identify mPV as a model disease to evaluate our CAAR T approach. In addition, we have made significant investment in the design and development of DSG3-CAART, generating a lead candidate that has demonstrated robust target engagement and no off-target toxicities in preclinical studies. Taken together, our Phase 1 clinical trial evaluating DSG3-CAART for the treatment of mPV represents an optimal first opportunity to establish initial clinical proof-of-concept of our CABA platform.

- **Leveraging our CABA platform to identify optimal targets for the CAAR T approach and apply learnings from DSG3-CAART to advance additional product candidates.** Shortly after inception, we undertook a comprehensive review of all known B cell-mediated autoimmune diseases in order to evaluate and prioritize the opportunity for selective destruction of B cells in an effort to cure B cell-mediated autoimmune diseases. Central to this analysis were (i) scientific, clinical and commercial assessment, (ii) epitope mapping to determine regions targeted by autoantibodies, (iii) evaluation of the ability to optimize the CAAR construct and design with the goal of selectively ablating reactive B cells, and (iv) evaluation of existing or required development of new preclinical models and *in vitro* and *in vivo* clinical testing. As we performed this analysis of potential product candidates, we considered possible paths for clinical trial design and regulatory approval. This analysis incorporated the extensive learnings gleaned from years of effort devoted to development of DSG3-CAART. We prioritized the targets and since then have been focused on being first to discover and develop a series of products with each providing the potential for cure of an important B cell-mediated autoimmune disease in patients. We intend to continue to apply our proprietary learnings from DSG3-CAART, including scientific and regulatory learnings, to most effectively advance these additional opportunities. Preclinical studies that are generally similar to, and informed by, DSG3-CAART preclinical studies are actively ongoing with other CAAR T cell product candidates.
- **Expanding upon our established IP position and first mover advantage in CAAR T therapy targeted towards B cell-mediated autoimmune diseases** We are focused on protecting our intellectual property as we continue to pursue the development of future product candidates. We believe the issued U.S. patent on our initial CAAR constructs is the first patent covering cells engineered to express the known pathogenic epitopes recognized by DSG3 and DSG1 autoantibodies, which we are working to supplement with additional patent filings. The design of a broadly effective CAAR requires a deep understanding of the location of immunogenic epitopes targeted by autoantibodies, a competency that we believe we are uniquely positioned to utilize in product candidate development. We believe there is a particularly high value to the first mover advantage including, but not limited to, experience in discovery, preclinical development, regulatory efforts, intellectual property and insights from clinical trials that can be translated across programs.
- **Leveraging our cellular therapy experience and knowledge in addition to knowledge gained through our Penn collaboration to rapidly build our own fully-integrated internal infrastructure.** We have differentiated expertise that we believe is uniquely suited for the continued buildout of our CABA platform specializing in B cell-mediated autoimmune diseases. Our scientific co-founders who initially developed our technology continue to collaborate closely with us through SRAs. In addition, our management team has a successful history of building the capabilities of cell therapy-based companies from the discovery and preclinical stage through Phase 3 readiness. In combination with our team, which possesses significant experience in executing on manufacturing strategies for cell therapy products, our partnership with Penn allows us to utilize their existing infrastructure, which accelerated our ability to submit our first IND. In parallel, we continue to build out an experienced team to manage the relationship with Penn while also developing and continuing to implement a path to our manufacturing independence. Ultimately, we intend to prepare and build our own manufacturing facility depending on the achievement of sufficient initial clinical trial data for DSG3-CAART.

B Cell-Mediated Autoimmune Diseases: Overview and Current Treatment Paradigm

The body's immune system, which is designed to protect the body from infection and cancer, includes B cells and T cells. B cells are responsible for producing antibodies against antigens that the body perceives as foreign whereas T cells are responsible for cell-mediated immunity. In the case of B cell-mediated autoimmune diseases, certain populations of the patient's B cells mistakenly produce antibodies directed against normal tissues and cells, leading to disease. While these autoantibodies are the major effectors of B cell-mediated autoimmune diseases, the underlying root cause of each B cell-mediated autoimmune disease is the defective B cells that mistakenly make these pathogenic antibodies. These pathogenic B cells express autoantibodies on their surface with the same antigen specificity as the circulating pathogenic autoantibodies, which can be used to distinguish them from the healthy B cell population, as shown in the figure below.



Antibodies are B cell receptors that drive B cell maturation. CD19 serves as a B cell marker throughout the naïve B cell phase, while CD20 is a surface marker expressed later in B cell maturation. CAAR T is designed to eliminate antigen specific B cells and prevent their further development to antibody producing plasma cells. IgM: immunoglobulin M; IgD: immunoglobulin D; IgA: immunoglobulin A; slg: surface immunoglobulin, representing the autoantibody on the B cell surface.

Current treatment options for autoimmune mediated diseases involve generalized immune suppression, achieved through corticosteroids, immunosuppressive medications and biologics. Most commonly, corticosteroids are used on both a chronic and acute basis to control disease, and act via a variety of mechanisms to control or downregulate multiple inflammatory pathways. In many cases, systemic immunosuppressive medications often used in chemotherapy such as mycophenolate, azathioprine and methotrexate, are added in an effort to minimize symptoms and manage the expected recurrences in patients. Biologic therapies have emerged as a new class of therapies and have a variety of targets including cytokines, B cells, and co-stimulation molecules. One particular biologic, rituximab, is an anti-CD20 antibody and is employed in multiple autoimmune diseases. Rituximab was approved by the FDA in 2018 for treatment of moderate to severe PV. Currently existing treatment options target parts of the immune system in addition to disease-causing B cells, and in general require chronic administration to reduce recurrence rates. We believe the ideal therapy in autoimmune diseases would completely and specifically eliminate the pathogenic B cells while sparing the immune cells that protect against infection, without requiring chronic administration.

Our Approach

Using our CABA platform, we are developing engineered T cell therapy candidates that express CAARs, which serve as “decoys” for antibodies expressed on the surface of B cells. We believe these CAARs enable the T cells to specifically engage and eliminate pathogenic B cells while sparing normal B cells. By harnessing the power of cell therapy, our technology has the potential to overcome the ability of these B cells to evade elimination and thus lead to durable responses. Our CAAR T platform is based on the foundation of established CAR T therapeutics, differing primarily in their use of the antigen rather than an antibody fragment to target pathogenic B cells. We

believe our technology has broad applicability and we are building a portfolio of product candidates for B cell-mediated autoimmune diseases.

Background: CAR T Cells

Engineered T cell therapy is a type of immunotherapy in which human T cells are genetically modified to express specific receptors, enabling the T cells to recognize and eliminate pathogenic cells.

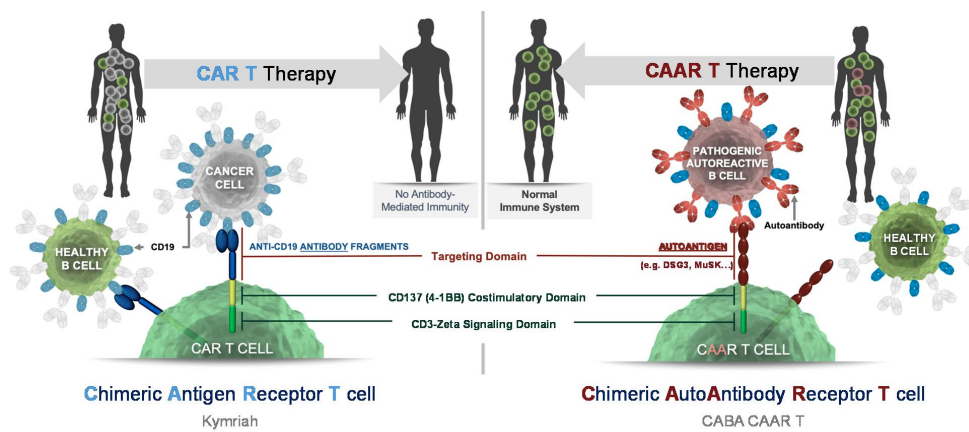
A key application of engineered cell therapy involves the use of CARs, which are engineered molecules that enable T cells to identify specific antigens present on the surface of diseased cells. When expressed on the patient’s T cells, the CAR directs the T cells to kill cells that express a particular antigen. These CAR-expressing T cells, or CAR T cells, can proliferate, generating memory CAR T cells.

Many companies are using CAR T technology to develop therapies for the treatment of B cell cancers. Several drug candidates have demonstrated clinical success, leading to the first FDA regulatory approvals of CAR T therapies for certain B cell cancers. In these B cell cancers, CAR T therapy has resulted in complete remission of disease in many patients, even in cancer patients with severe, refractory disease. Despite success in treating certain B cell cancers, we believe that CARs have not yet been developed or evaluated as a treatment option for other types of B cell-mediated autoimmune diseases in patients.

Our Technology: CAARs

Our CAAR T platform builds upon the scientific foundation of CARs to enable targeted B cell elimination in an autoimmune setting, which may lead to complete and durable remission of disease while sparing all other B cell populations that can provide beneficial immunity from infection.

The co-stimulatory domain and the signaling domain of both a CAR T cell and CAAR T cell carry out the same activation and cytotoxic functions once the engineered cell therapy engages a B cell. Our CAAR T cells differ from CAR T cells primarily in the extracellular targeting domain. Our CAAR T cells incorporate the relevant parts of the autoantigen that is subject to attack in autoimmune disease, as shown in the figure below.



Key differences between CAR T (left) vs. CAAR T therapy (right) A CAR T cell typically contains a signaling domain and a co-stimulatory domain and incorporates antibody fragments that recognize a specific antigen, such as CD19, which is present in both B cell leukemia cells and healthy B cells. In contrast, a CAAR T cell typically contains an antigen as its targeting domain rather than an antibody fragment. The antigen is recognized by the specific, pathogenic antibody along with the limited population of B cells that produce the antibody. The model

CAAR T cell depicted here contains an identical signaling domain and a co-stimulatory domain. The primary difference between a CAR T cell and a CAAR T cell is the target domain expressed on the cell surface. The example shown demonstrates the pan-B cell ablation that happens when targeting the B cell lineage marker, CD19, and the highly selective pathogenic B cell targeting approach of CAAR T.

Potential Advantages of CAAR T Cell Therapy in B Cell-Mediated Autoimmune Diseases

In contrast to currently available therapies for B cell-mediated autoimmune diseases, based on observations of CAR T activity in refractory B cell cancers, we believe a single CAAR T treatment could potentially offer complete and durable remission of certain specific B cell-mediated autoimmune diseases while leaving the humoral, or bodily fluid, antibody-producing immune system intact. We believe our CAAR T cells can recognize the specific autoantibodies that are responsible for causing an underlying disease and kill the cells that express the autoantibodies on their surface. As a result, we believe CAAR T cell therapy used in B cell-mediated autoimmune disease has the potential for durable elimination of pathogenic B cells and an associated elimination of clinical recurrences with an improved adverse event, or tolerability, profile relative to the current standard of care.

Enhanced target specificity and preservation of humoral immune system

Preservation of the humoral immune system with CAAR T cell therapy represents a potentially meaningful benefit over existing CD19- or CD20-targeting methods for B cell ablation, as patients would be less susceptible to infection they may encounter after non-specific B cell elimination and would not require chronic in-hospital treatment with intravenous immunoglobulin, or IVIG, or other prophylactic therapies. Additionally, because self-reactive B cells make up only 0.01% to 1% of the normal B cell population, we believe the risk of on-target toxicity may be reduced compared to systemically immunosuppressive medications that non-specifically weaken the immune system. Continued use of these drugs poses significant risks, such as the potential for fatal infections due to the non-specific tempering of the immune system related to the complete depletion of CD20+ or CD19+ B cells.

Potential for complete, long-lasting elimination of pathogenic B cells

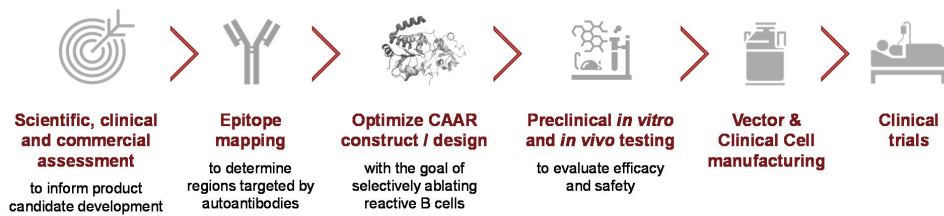
The current standard of care for B cell-mediated autoimmune disease displays limited and transient therapeutic benefit while also weakening the humoral immune system. We believe our CAAR T cells have the potential to eliminate the reactive, antibody-producing B cells that are ultimately responsible for disease, while sparing normal B cells. The curative potential of CAAR T cells would be consistent with clinical findings from use of CAR T products in B cell cancers and would be a significant improvement relative to the current standard of care for certain B cell-mediated autoimmune diseases.

While CAR T has demonstrated significant clinical success in B cell cancers, cancer cells employ a variety of mechanisms to evade detection by targeting immune cells, and antigen escape poses a significant risk of failure for CAR T cell treatment in oncology. Antigen escape in CAR T treatment occurs when the antigen that the CAR T cell targets is lost from the malignant cell. Clinically, this results in response rates that decline from an initial complete response level of about 80% to approximately 50% over a period of years.

We believe this risk of antigen escape is reduced in our setting as mechanisms to evade CAAR T therapy would involve B cell receptor down-regulation or mutation such that antigen specificity is lost. We believe that the implication of this is that the mutated B cell would no longer produce autoantibodies that recognize the antigen and therefore should no longer be pathogenic. We also believe that a single infusion of CAAR T cells has the potential for curative effects due to either complete ablation of pathogenic cells or production of memory CAAR T cells.

Our CABA Platform

Our team has developed our CABA platform to inform product candidate development from indication selection through preclinical studies. Using our CABA platform, our team has identified our highest priority target indications following a rigorous analysis of B cell-mediated autoimmune diseases. A deep understanding of the antigenic epitopes targeted in these diseases is required to design and construct a successful CAAR. Our scientific founders have studied B cell repertoires for many years in the context of PV. Their expertise is essential to provide insights and guidance regarding our portfolio of products. We leverage the experience and insight gained from the development of each product candidate to improve the efficiency of our CABA platform in evaluating additional potential product candidates.



Scientific, Clinical and Commercial Assessment

Through broad literature review and consultation with internal and external experts, we have identified and continue to monitor the universe of diseases where pathogenic B cells are implicated in disease pathophysiology. From this set of possible indications, our team then evaluates each disease based on numerous criteria, which include, but are not limited to:

Biologic Opportunity for Cure

- the presence of the antibody is well established in patients with the clinical manifestations of the disease;
- the identified antibody has been shown to be necessary and sufficient in causing clinical disease;
- there is a correlation between antibody titer and disease activity;
- B cell-depleting therapies are shown or believed to be effective in treating the disease;
- the antibody repertoire has been or can be characterized for the disease;

Identifiable and Underserved Patient Populations

- a routine and established antibody test exists or can be developed for diagnosis and biomarker assessment;
- the clinical course and severity of the disease warrant a cellular therapy despite current standard of care;
- products in development do not have the potential to materially improve outcomes versus the current standard of care;

Evaluation of Preclinical and Clinical Development Pathway

- preclinical *in vitro* and *in vivo* models exist or can be developed; and
- potential clinical trial designs and endpoints appear reasonable and achievable.

In addition to assessing the underlying biologic and clinical rationale for each potential target, we also assess commercial feasibility of CAAR T therapy in various B cell-mediated indications. As part of this assessment, we evaluate the direct lifetime drug and overall healthcare costs due to the burden from the disease, including the costs of managing potential adverse effects from existing standard of care compared to the potential CAAR T therapy.

We perform this rigorous and detailed conceptual analysis to enable us to be thorough and thoughtful before committing significant resources to a program. We believe this analysis allows us to prioritize and advance potential product candidates through the CABA platform with a higher degree of confidence and a higher probability of success.

Epitope Mapping

Epitope mapping involves identifying specific sites on the antigen that are responsible for binding to the antibody of interest. This step is required in order to facilitate an understanding of CAAR design and feasibility. An understanding of the locations of the key immunogenic epitopes on the antigen heavily informs the potential feasibility of a CAAR. With an understanding of these epitopes, we then leverage our cell therapy expertise to design the CAAR construct.

CAAR Construct / Design

Our scientists and collaborators design and create multiple CAAR constructs following completion of epitope mapping, which are tested against the antibody or antibodies of interest. The goal in CAAR design is to maximize the inclusion of known immunogenic epitopes on the antigen while also optimizing the size of the construct to improve the ability of the CAAR to bind to the antibody. Determining the location of antigen expression and if there are other antigens that may unintentionally cross-react with the CAAR will also inform CAAR design and feasibility. The size of the antigen will also determine whether a CAAR can be designed based on the size constraints of the delivery system. Once we have designed and developed optimal CAAR constructs, we test them in a variety of *in vitro* and *in vivo* studies.

In Vitro and In Vivo Testing

In vitro preclinical testing is focused on establishing the specificity and activity of the potential CAAR T cell product candidate against B cells expressing known pathogenic target antibodies. Specificity is evaluated against non-target membrane proteins that may be expressed on other cells, with specific focus against any proteins that are known to bind to the antigen presented on the CAAR. CAAR T function is tested in the presence and absence of soluble, or free, antibodies isolated from patients, since these antibodies may enhance or inhibit CAAR T cell function. Where relevant animal models exist, the CAAR T cell product candidate is tested in one or more models to address specific questions around safety and the ability of the potential product candidate to reduce disease activity *in vivo*.

Pipeline

We are developing a portfolio of CAAR T cell product candidates for the treatment of B cell-mediated autoimmune diseases. Our lead product candidate, DSG3-CAART, targets B cells that express pathogenic autoantibodies against the DSG3 protein, which cause mPV. The publication of the first *in vivo* evaluation of activity and toxicity of the candidate in an animal model was followed by additional preclinical studies to support our IND submission, which was cleared by the FDA in September 2019. The FDA granted our lead product candidate, DSG3-CAART, designed to treat patients with mPV, orphan drug designation for the treatment of PV in January 2020 and fast track designation for improving healing of mucosal blisters in patients with mPV in May 2020. We initiated our DesCAARTes™ trial in June 2020 and announced the dosing of the first patient in December 2020. Our next PV-directed product candidate, DSG3/1-CAART, targets B cells that give rise to pathogenic autoantibodies against either the DSG3 or DSG1 protein, which cause mcPV, and could address a broader PV population.

Our second product candidate, MuSK-CAART, targets B cells that give rise to pathogenic autoantibodies against the MuSK receptor in patients with MG. An additional product candidate, FVIII-CAART, targets B cells that produce alloantibodies against exogenous FVIII in Hemophilia A patients who consequently require repeated and increased exogenous FVIII administration. In May 2020, we expanded our Payne SRA to include CAAR design and optimization efforts in three additional B cell-mediated autoimmune diseases. We are exploring additional CAAR T cell product candidates that will focus on patients with B cell-mediated autoimmune diseases with well-defined antibody targets.

Our Product Candidates

DSG3-CAART for Mucosal PV

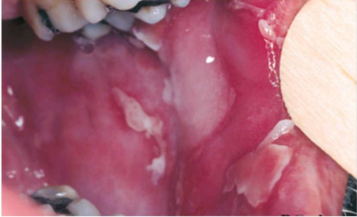

Our lead product candidate, DSG3-CAART, is a CAAR T cell therapy expressing DSG3 antigen epitopes as the extracellular domain of a chimeric immunoreceptor, and is designed to enable specific cytotoxicity toward B cells with DSG3 autoantibody targeting abilities. We believe this strategy has the potential to enable direct elimination of DSG3 autoantibody memory B cells and indirect elimination of DSG3-specific short-lived plasma cells that produce the pathogenic autoantibodies.

Scientific, Clinical and Commercial Assessment

PV is a potentially fatal, chronic autoimmune disease characterized by acantholysis, which is the loss of adhesion between cells of the skin or mucous membranes. Desmosomes are a collection of proteins that provide the structure for epithelial cells to connect with each other. PV results when specific pathogenic autoantibodies disrupt desmosomes by targeting DSG3 and/or DSG1, which are proteins that are part of the desmosomes. These autoantibodies cause the upper layer of the epidermis to split away from its base resulting in characteristic erosions and blisters. Widespread damage to the skin and mucous membranes increases susceptibility to life-threatening systemic infections. PV has two major subtypes:

- mPV—Characterized by DSG3 autoantibodies only, affecting only mucosal surfaces—accounts for approximately 25% of PV
- mcPV—Characterized by DSG3 autoantibodies and DSG1 autoantibodies, affecting both mucosal and cutaneous surfaces—accounts for approximately 75% of PV

The presence of DSG-specific antibodies is 98% to 100% sensitive and specific in identifying patients with PV and these antibodies have been deemed both necessary and sufficient to cause the disease. Thus, in the absence of DSG autoantibodies, PV generally does not occur. In mPV, patients will typically develop painful skin blisters on their mucosal membrane surface, including mouth, nose, throat, genitals, and other orifices, often leading to an inability to eat, drink and function normally. The pathogenic DSG3 autoantibody is made by a specific small number of aberrant B cells, which express the DSG3 autoantibody on their surface. An overview of mPV and mcPV is provided in the figure below.

	Mucosal PV 25% of U.S. pemphigus vulgaris	Mucocutaneous PV 75% of U.S. pemphigus vulgaris
		
Associated Antibody	Anti-DSG3	Anti-DSG3 + Anti-DSG1
Clinical Signs	Painful blisters of the mucous membranes (mouth, nose, larynx, esophagus, eyes, genitalia, rectum)	Blisters on orifices and skin
US Disease Prevalence	3,250 to 4,750	9,750 to 14,250

Visual evidence of clinical manifestations of PV. (Left panel) Inside of cheek of a patient with mPV, showing sloughing mucosa and blistering. (Right panel) Back of a patient showing cutaneous skin blistering and sloughing in a patient with mcPV. Image credit: D@nderm.

Like most autoimmune diseases, the current standard of care for PV relies on general immune suppression, which is often transiently effective but can lead to severe infection, potentially resulting in hospitalization and death. First-line therapy for PV typically consists of corticosteroids in moderate to high doses in combination with the anti-CD20 monoclonal antibody rituximab where clinically appropriate. Second-line therapy focuses on the several systemically immunosuppressive medications such as mycophenolate, azathioprine and methotrexate. Additional options used in the acute setting with severe disease presentation include plasmapheresis, or infusions of intravenous immunoglobulin.

B cell depletion with rituximab was approved by the FDA for the treatment of PV in 2018 and is playing an increasing role as part of the standard of care because it has proven to be one of the more effective therapies for PV. However, data suggest that a significant number of patients treated with rituximab will relapse with or without chronic therapy. Despite its recent approval for use as an adjuvant therapy with corticosteroids in PV, rituximab has several limitations in terms of efficacy, safety and convenience. Rituximab treatment frequently results in relapse, which is reduced but still occurs despite chronic treatment every six months in PV. It does not specifically target the pathogenic B cells, but rather it depletes all CD20-expressing B cells, which leads to an ongoing risk of severe infection and death. As such, there remains not only an unmet medical need in PV, but also a need for safer therapies that can provide a reliable, durable and complete remission off of all other medications.

There are several emerging therapies also being developed for the treatment of PV, which are being evaluated in late-stage clinical trials. These therapies provide important alternative therapeutic options for patients; however, we believe based on early published data that these therapies are unlikely to be curative and do not specifically ablate antibody producing B cells.

Epitope Mapping

DSG3 consists of five extracellular cadherin, or EC, domains as shown schematically in the figure below. Since T cell activation depends on the intermembrane distance of the immunologic synapse, we tested different combinations of ECs for expression in primary human T cells using DSG3 fragments as the extracellular domain as shown in the figure below.

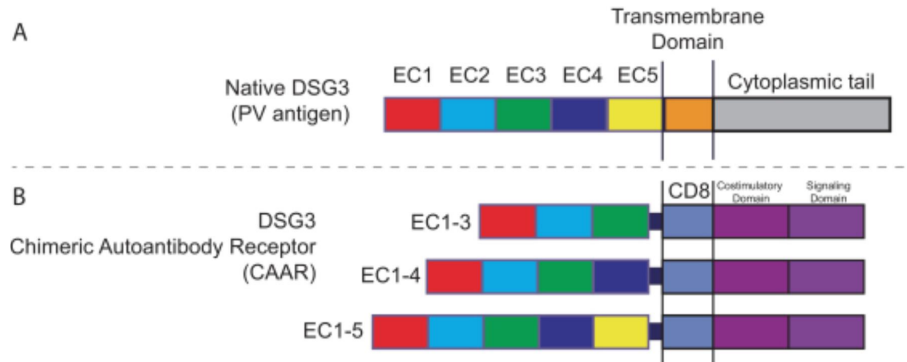
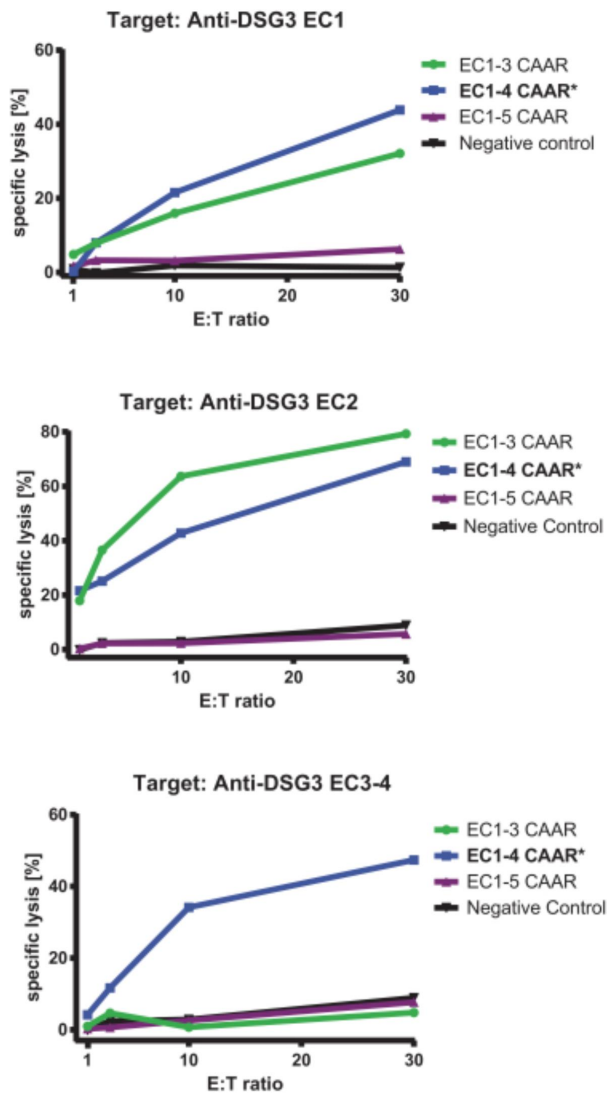


Image showing the naturally occurring DSG3 protein and the five EC domains. (B) The CAAR constructs that were evaluated in preclinical studies, containing the whole or subsets of the DSG3 protein. The transmembrane and intracellular signaling domains are identical to those in the CART19 studies published by Penn.

CAAR Construct / Design

The DSG3 EC1-5 CAAR was minimally functional, likely due to the extracellular domain being too large to enable CAAR function or aggregation of the CAAR on the T cell surface. The CAAR designs with either DSG3 EC1-3 or DSG3 EC1-4 showed interferon-gamma production after exposure to the target cells, demonstrating specific cytotoxic activity across targets. In addition, no cytokine production was detected after exposure to cells that did not express surface immunoglobulins or other non-target cells.

The DSG3 EC1-3 was not effective against one target cell known to bind to the DSG3 EC3-4 domain. Together, this data suggests that the DSG3 EC1-4 CAAR is the optimal construct to balance activity while retaining the ability to target locations of known pathogenic antibodies, as shown in the figures below.



Cytotoxicity assay to assess killing activity of DSG3 CAART. Negative control is a CAR T with an antibody fragment attached to the extracellular domain. * indicates construct that was selected for further development. E:T ratio = effector to target ratio.

In Vitro Studies

A variety of *in vitro* studies were conducted to evaluate DSG3-CAART from a preclinical activity and toxicity perspective. These studies included an evaluation of DSG3-CAART against proteins that are known to bind the DSG3 antigen, a screen of DSG3-CAART against an array of other membrane proteins and a set of studies designed to evaluate the potential effects of soluble DSG3 antibodies against DSG3-CAART. The results of these studies are summarized below.

Evaluation of DSG3-CAART reactivity against known DSG3 binding proteins. The DSG3 antigen presented on the extracellular domain of DSG3-CAART may naturally bind proteins in the body. These proteins may bind to and activate DSG3-CAART, potentially causing toxicity. The native binding proteins for DSG3 are the desmocollin proteins, which are important for cell adhesion in the skin and mucosa. We performed a variety of studies to test whether DSG3-CAART recognizes and activates the desmocollin proteins. Epithelial cells isolated from various primary organ systems that express some level of desmocollin proteins were screened. Potential DSG3-CAART activity was evaluated through the detection of cytokines released against each cell type and cytotoxicity. The data demonstrated an absence of inflammatory T cell cytokines after being exposed to these cells, indicating an absence of T cell activation. No cytotoxicity was detected except at very high, non-pharmacologically feasible doses. Collectively, we believe there is sufficient evidence to suggest that the DSG3 protein in the context of a CAAR does not meaningfully interact with desmocollin proteins.

Evaluation of DSG3-CAART off-target binding against membrane proteins. A membrane protein array was utilized to screen the DSG3-CAART extracellular domain against 5,300 membrane proteins, which encompass the approximate number of membrane proteins contained in the human genome. The confirmatory screen yielded no off-target signals, except for one weak signal against a protein that is known to bind to glycoproteins, and which was detected in both the test and control conditions. Further evaluation of this protein in cell-based assays indicated that DSG3-CAART does not recognize and activate against this protein.

Evaluation of the effect of soluble antibodies on DSG3-CAART function. We expect that circulating antibodies may prompt an active immune response against treatment with CAAR T cell therapy. These antibodies can induce proliferation of DSG3 CAAR T cells but may also neutralize the cells. In our preclinical *in vitro* studies, we observed that while DSG3 antibodies may have a variable effect on CAAR function, there was no systematic effect to enhance or reduce CAAR function. These dynamics were evaluated in a series of *in vitro* studies as follows:

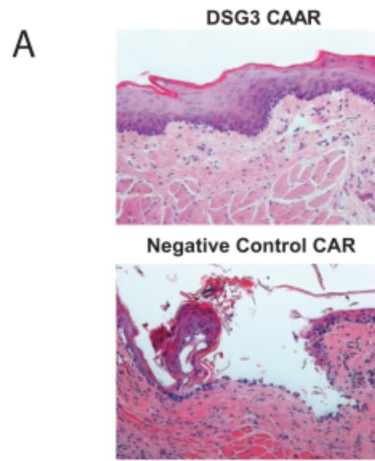
- *Soluble DSG3 antibodies were added to CAAR T cell cytotoxicity assays, at a range of concentrations likely to be encountered in patients, to assess the impact on CAAR function.* In all cases when the CAAR T cells were tested in the presence of soluble DSG3 antibodies, they retained their killing function. In addition, the presence of antibodies did not demonstrate a systematic effect to enhance or reduce the CAAR T cells' cytotoxic ability. Therefore, we believe that removal of circulating soluble DSG3 antibodies from patients prior to infusions may not be necessary to enable potential benefit.
- *Monoclonal DSG3 antibodies with an enhancing effect were evaluated in combination with PV patient serum to assess their impact on DSG3 CAAR T cell division and stimulation of cytokine production.* Monoclonal DSG3 antibodies were capable of inducing DSG3 CAAR T cell division and stimulated production of moderate levels of cytokine production, as measured by interferon gamma. Therefore, we believe the presence of DSG3 autoantibodies in patients may contribute to the DSG3 CAAR T cell population expansion post-infusion.
- *Antibodies purified from PV patients were added to DSG3 CAAR T cells at a range of concentrations known to commonly occur in patients in order to evaluate the extent to which patient serum may activate CAAR T cells.* These antibodies induced a dose dependent increase in interferon gamma.

- *Off-target toxicity may also be seen due to antibody-mediated bridging of DSG3 CAAR T cell cytotoxicity against hematopoietic cells that express receptors designed to bind to antibodies, known as Fc receptors.* To evaluate this, we loaded DSG3 antibodies onto cells expressing antibody-binding receptors, and evaluated the ability of DSG3 CAAR T cells to bind and activate against these targets *in vitro*. No evidence of cytotoxicity was observed, suggesting the potentially low risk of off-target killing mediated by this mechanism.

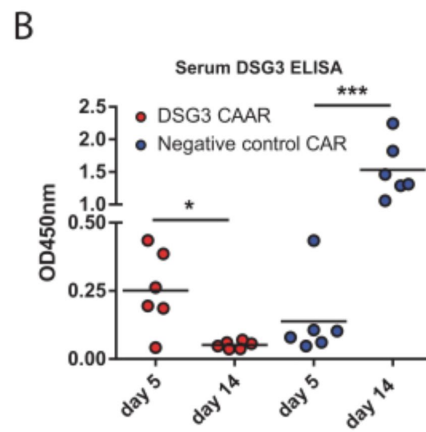
In Vivo Studies

To evaluate DSG3-CAART *in vivo*, four murine models were used. These models were designed to directly compare the potency of DSG3-CAART in comparison with CART19 cells; evaluate the potential for on-target skin toxicity; and measure the activity of DSG3-CAART in the presence of polyclonal soluble DSG3 antibodies.

- *Evaluation of potency of DSG3-CAART in a human B cell tumor line compared to CART19 cells.* This B cell model contained genetically-modified B cells to express DSG3 antibodies on the cell surface in addition to luciferase, a bioluminescence marker, and allowed evaluation of DSG3-CAART's ability to engage and kill B cells that express the pathogenic antibody. CART19 cells were used as a positive control in this model as the B cells express CD19 on their cell surface. In this model, DSG3-CAART was found to result in a similar reduction of B cells compared to the CART19 cells.
- *Evaluation of on-target skin toxicity mediated by DSG3-CAART.* A human skin-xenografted model was used to evaluate the potential skin toxicity of DSG3-CAART by evaluating if the extracellular domain would react with desmocollin proteins, which are the known target for DSG3. These results were compared directly to a positive control CAR T expressing a DSG3 specific antibody as an extracellular domain. In this model, we observed the absence of skin toxicity mediated by the DSG3-CAART cells compared to the positive control, which did demonstrate skin toxicity.
- *Evaluation of DSG3-CAART in the presence of soluble antibodies.* We also tested a model where mice have circulating DSG3 antibodies to mimic the situation in PV patients. In this model, the DSG3 antibodies have well-defined and different epitopes with varying affinities, which may reflect the potential breadth of B cell targets that could be encountered in PV patients. The mice were then treated with DSG3-CAART, which was compared to non-CAAR expressing T cells, or negative control CAR T cells. In this model, we observed amelioration of disease (see figure A below), reduction of DSG3 antibody titers (see figure B below), as well as control of the pathogenic B cells (see figure C below), by DSG3-CAART. In this model, DSG3-CAART also demonstrated dose-related activity, particularly in regard to reduction of serum autoantibodies, epithelial-bound autoantibodies (not shown in Figures) and DSG3-CAART engraftment, suggesting that higher DSG3-CAART doses may promote engraftment (see Figures D and E). We believe these results show the functional activity of DSG3-CAART in the presence of soluble antibody.

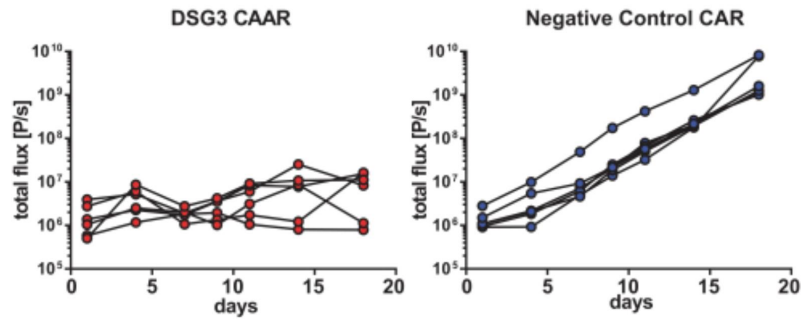


Histology showing DSG3 CAAR maintaining normal epithelial cell structure in treated animals.



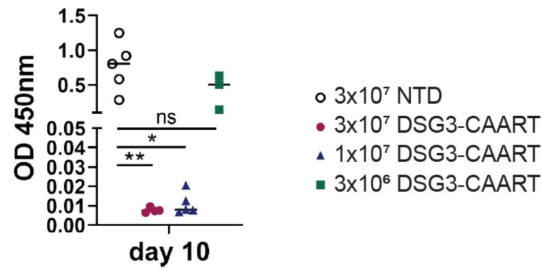
*OD450 is a proxy measure for anti-serum DSG3 antibodies in the blood. * indicates statistically significant reduction in DSG3 serum antibody level in DSG3-CAART treated mice. P value is < 0.05. *** indicates statistically significant increase in DSG3 serum antibody level in the negative control CAR treated group. P value is < 0.001.*

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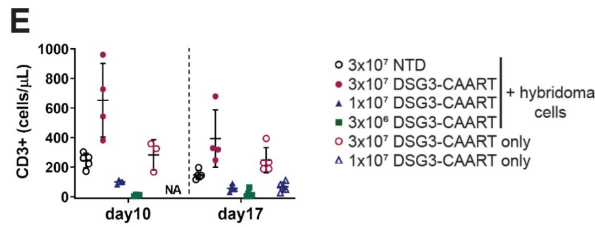


Total flux is a quantitative measure of cell bioluminescence, which approximates cell activity in this assay.

D

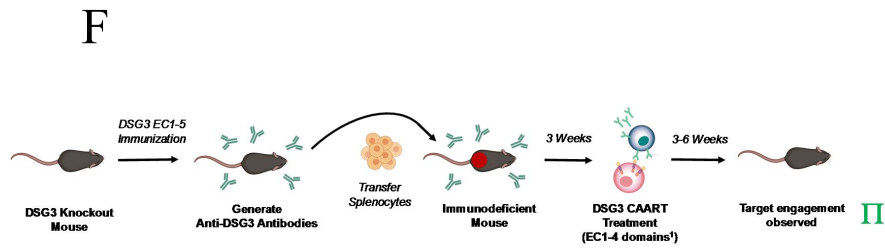


OD450 is a proxy measure for the level serum anti-DSG3 antibodies in the blood. Serum anti-DSG3 ELISA was performed on day 10 for all mice with remaining serum samples available, indicating that mice treated with the 3x10⁷ and 1x10⁷ DSG3-CAART dose effectively reduced serum anti-DSG3 IgG production compared to mice treated with NTD T-cells or the 3x10⁶ DSG3-CAART dose. ** indicates statistically significant reduction in DSG3 serum antibody level in DSG3-CAART treated mice. P value is < 0.01. * indicates statistically significant increase in DSG3 serum antibody level in the negative control CAR treated group. P value is < 0.05. ns indicates a non-significant difference.



Quantification by flow cytometry of CD3-positive T-cells in peripheral blood on day 10 and 17 is shown. The data support dose-related DSG3-CAART engraftment based on increased CD3+ cells with increased DSG3-CAART dose.

- *Evaluation of DSG3-CAART in an active immune model.* An exploratory active immune mouse model for PV was developed to better represent the human phenotype in autoimmune disease. This model involved generating anti-DSG3 B cells in a mouse without DSG3 by repeated immunization with human DSG3. Splenocytes containing anti-DSG3 B cells from the immunized mouse were transferred into an immunodeficient mouse to generate the PV phenotype. These mice produced DSG3 antibodies against multiple extracellular domains of the DSG3 antigen, including EC5, at physiologic levels comparable to those observed in PV patients. Treatment with DSG3 EC1-4 CAAR T cells, in the absence of preconditioning, effectively lowered serum DSG3 antibody levels by ELISA, reduced antibodies against relevant DSG3 domains by epitope mapping and reduced blistering by histology. These mice retained autoantibodies targeting the DSG3 EC5 region, though the mice did not show clinical manifestations of PV.
- See figure F below for a schematic representation of the experiment.



Schematic representation of the PV active immune model. A DSG3 knockout mouse is immunized with DSG3 EC1-5. The knockout mouse develops antibodies against DSG3 across all EC domains. The splenocytes from the knockout mouse are transferred to an immunodeficient mouse where the DSG3 antibodies cause a clinical phenotype consistent with PV. Those mice are then treated with DSG3-CAART (EC1-4 domains only).

Clinical Development Plan

The FDA cleared our IND for a Phase 1 trial of DSG3-CAART in September 2019. The FDA granted DSG3-CAART orphan drug designation for the treatment of PV in January 2020 and fast track designation for improving healing of mucosal blisters in patients with mPV in May 2020. We announced that the first patient was dosed in the DesCAARTes™ trial in December 2020. The DesCAARTes™ trial is an open-label trial to assess the safety and tolerability of various dosing regimens of DSG3-CAART in the treatment of subjects with active mPV. DSG3-CAART will be administered by intravenous infusion, using a fractionated-dose infusion scheme of escalating numbers of DSG3-CAART cells for the initial cohorts in the first phase. This dosing scheme is designed to reduce the potential risks associated with acute infusion-related toxicities while preserving potential benefit for subjects by

allowing a total infused dose that we believe is large enough to be potentially therapeutic based on prior CAR T trials.

We expect that the Phase 1 trial will have three parts:

- Part A: Fractionated dose escalation
- Part B: Fractionation reduction at the selected dose
- Part C: Expansion phase at the selected dose and administration scheme

In Part A, the split dose uses dose fractionation to accommodate a low number of cells in the first infusion while still advancing the dose within the cohort up towards and spanning the range of cell doses that have been therapeutic in past gene-engineered T cell therapy trials. In Part B, the dose selected from Part A will be delivered in a decreasing number of dose fractionations to determine the dose fractionation strategy. In Part C, subjects will be enrolled at the dose and fractionation, as determined in Part A and B, to generate additional safety and outcome data to support the rationale for and design of future clinical trials.

Patients are eligible to be enrolled if they have a confirmed diagnosis of mPV based on biopsy for histology and positive DSG3 ELISA; active disease at screening; elevated DSG3 by ELISA at screening; and previously been inadequately managed by, or refractory to, or relapsed after, or with contraindications to or intolerance of at least one prior systemic therapy. The primary objective of the trial is to evaluate the safety of DSG3-CAART cells, and secondary objectives include evaluating the initial signs of target engagement.

We believe the risk of cytokine release syndrome, or CRS, a potentially life-threatening toxicity that has been observed after treatment with some types of immunotherapy, may be reduced with our CAAR T cells, due to its correlation with target cell burdens. In the context of treating cancer, the target cell population consists of all B cells (healthy and cancerous), whereas our CAAR T cells only target the small subset of disease-causing reactive B cell population. While the possibility of cytokine release in a clinical trial resulting from strongly activating soluble antibody cannot be ruled out, to date we have not observed any evidence of it in preclinical studies.

The primary endpoint of the study is the incidence of adverse events within three months of DSG3-CAART infusion, including dose limiting toxicity defined as occurring within 28 days of infusion. The FDA has requested, and we have agreed, that we will share data from cohort A to inform a discussion on the optimal design of cohort C. According to FDA guidance, the submission of cohort A data is not gating to planned enrollment in cohort B and the FDA plans to provide feedback, if any, in a timely manner. In addition, we plan to report on acute tolerability data on no less than a cohort basis, which is defined to include adverse events within eight days following DSG3-CAART infusion. We believe the eight-day timeframe appropriately covers the period of time when one would expect the onset of CRS in most subjects. We also currently intend to communicate serious adverse events once we have sufficient understanding of the events, if they materially change timelines or the trial design.

We also expect to provide updates from time-to-time related to target engagement in subjects receiving DSG3-CAART typically only once data is available for a full cohort. Although possible but not expected in the lower dosing cohorts, we believe target engagement could be observed if DSG3 autoantibody titer falls within six months after DSG3-CAART infusion in addition to other parameters of engraftment and target engagement that will be monitored regularly. Clinical responses, including improvement or resolution of mucosal lesions and absence of new lesions will also be evaluated.

DSG3/1-CAART for mcPV

Scientific and Commercial Assessment

Our next PV product candidate, DSG3/1-CAART, is being designed to target DSG3 and/or DSG1 autoantibodies on pathogenic B cells that cause mcPV. mcPV is the most severe and most common subtype of PV and affects approximately 75% of PV patients. While mPV is caused by DSG3 autoantibodies, mcPV involves autoantibodies to both DSG3 and DSG1, resulting in the additional involvement of skin erosion and blistering.

Similar to mPV, mcPV is typically treated with immune suppression, which has a high rate of relapse and potential for hospitalizations and fatal infections.

Epitope Mapping

DSG1 consists of five EC domains, with all known pathogenic epitopes occurring in the DSG1 EC1-4 domains. Similar to development of DSG3-CAART, we tested different combinations of DSG1 ECs for expression in primary human T cells using DSG1 fragments as the DSG1 EC domains. Given prior development of DSG3 CAAR, we leveraged those findings in the design of our DSG1 CAAR.

CAAR Construct / Design

We also tested multiple combinations of EC domains of DSG1 CAAR administered alone and in combination with the DSG3 EC1-4 CAAR to evaluate for cell-surface expression of the CAAR along with the potency and breadth of target cell killing. In this setting, the DSG1 EC1-4 CAAR showed robust and specific cytotoxicity towards all known pathogenic epitopes.

In Vitro Studies

CAAR development for mcPV, based on the targeting of DSG3- and/or DSG1-specific B cells, has shown promising preclinical results. DSG1 CAAR T cells specifically killed DSG1-specific B cells *in vitro*. In addition, we observed that with a 1:1 mixture of DSG3 and DSG1 CAAR T cells had killing capabilities without synergistic or antagonistic effect.

In Vivo Studies

The activity and toxicity of DSG3 and DSG1-CAAR T cells was evaluated using human skin xenografts in comparison with anti-CART19 cells, which are known from human clinical trials not to cause direct skin toxicity. A 1:1 mixture of DSG3 and DSG1 CAAR T cells did not show off-target toxicity *in vivo*.

Development Plan

From a regulatory and clinical trial design perspective, we anticipate that many of the elements incorporated into the planned DesCAARTes™ trial will carry over to DSG3/1-CAART. We plan to evaluate the initial cohorts of patients from the planned DesCAARTes™ trial to evaluate for safety and evidence of target engagement prior to proceeding with an IND submission for DSG3/1-CAART. We believe that, because mcPV is the most prevalent subset of PV and the patients are generally followed by the same subspecialists, it will allow for a wider patient pool eligible for a clinical trial. We anticipate the DSG3/1-CAART clinical trial protocol will have a significant amount of overlap with the DSG3-CAART protocol, but it will be informed by clinical data from the early cohorts in the DesCAARTes™ trial. We further anticipate being able to use the same centers from the DesCAARTes™ trial to enroll patients for the DSG3/1-CAART clinical trials.

We are currently evaluating advanced manufacturing technologies that would potentially allow us to administer DSG3/1-CAART as a single product rather than requiring separate administration. The size of the DSG3/1 product candidate will likely require us to incorporate additional technologies to accommodate the size of the final CAAR construct. An evaluation of potential technologies to achieve this objective is ongoing. Upon completing the evaluation of these manufacturing technologies, we expect to conduct additional *in vitro* and *in vivo* studies using the combined product. While a product that administers a DSG3 CAAR and DSG1 CAAR as two separate products may be feasible, we believe that there would be significant advantages to developing a combined product from a regulatory and commercial perspective.

MuSK-CAART for MuSK Myasthenia Gravis

Scientific, Clinical and Commercial Assessment

MG is an autoimmune disease induced by autoantibodies targeting the neuromuscular junction, or NMJ, which can lead to life-threatening muscle weakness. Generalized MG, or gMG, is characterized by profound muscle weakness throughout the body, resulting in motor impairment, disabling fatigue, shortness of breath due to respiratory muscle weakness and episodes of respiratory failure.

gMG affects approximately 50,000 to 80,000 patients in the United States. The majority of patients who develop gMG have autoantibodies against some part of the NMJ that are known to be pathogenic. 80% to 90% of patients with gMG have autoantibodies against the acetylcholine receptor, or AchR, detectable in their serum. Approximately 6% to 7.5% of patients with gMG have autoantibodies against MuSK, which is a different target on the surface of the muscle membrane.

Patients diagnosed with MuSK MG have a different recommended treatment course compared to patients with AchR MG. Importantly, many patients with MuSK MG respond poorly to cholinesterase inhibitors, which are often the first line of therapy in AchR MG. In that setting, patients with MuSK MG are typically started on corticosteroids in addition to one or more steroid-sparing immunosuppressive agents. Corticosteroids are tapered to the extent possible to prevent disease relapse, though many remain dependent on corticosteroid despite concomitant treatment with immunosuppressive medications. In the acute setting, plasmapheresis or intravenous immunoglobulin may be used to address severe disease. Rituximab is often considered as a second-line therapeutic option in patients with an inadequate response to initial immunosuppressive medications. Importantly, complement is not thought to be meaningfully implicated in the pathophysiology of MuSK MG, and complement inhibitors are not indicated for treatment of disease.

Epitope Mapping

The MuSK protein has a similar structure and size as compared to DSG3. MuSK contains four extracellular domains, as shown below.

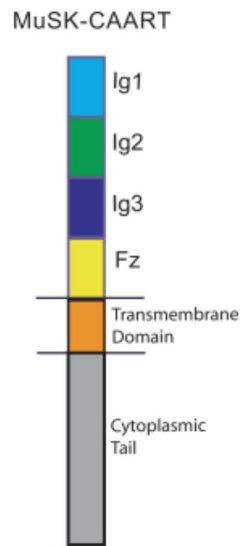


Figure illustrating the domains of the wild-type MuSK protein.

Studies conducted in patients with MuSK MG have revealed that the autoantibodies may be against epitopes located in each of the extracellular domains for MuSK.

CAAR Construct and Design

With an understanding that pathogenic autoantibody epitopes may target any domain of MuSK, multiple MuSK CAAR candidates have been engineered that incorporate all extracellular domains. Each CAAR construct is being or will be tested in preliminary *in vitro* and *in vivo* experiments.

In Vitro Studies, In Vivo Studies and Development Plan

Data from our initial *in vitro* and *in vivo* studies of MuSK-CAART was presented at the American Academy of Neurology's Science Highlights Virtual Platform in May 2020. The efficacy and safety of MuSK CAAR T cells were investigated using *in vitro* cytotoxicity assays, *in vitro* screens for off-target toxicity and a mouse model to evaluate the efficacy of human MuSK CAAR T cells against MuSK antibody expressing B cells *in vivo*. In preclinical studies, MuSK CAAR T cells containing the native MuSK extracellular domain demonstrated *in vitro* cytotoxicity towards a panel of B cells expressing anti-MuSK antibodies specific for different extracellular regions of the MuSK protein, but no observed cytotoxicity when anti-MuSK antibodies are not expressed (figure below). Additionally, MuSK CAAR T cells did not demonstrate cytotoxicity toward cells expressing LRP4, which is a different protein in the neuromuscular junction that can bind with naturally occurring MuSK in certain configurations.

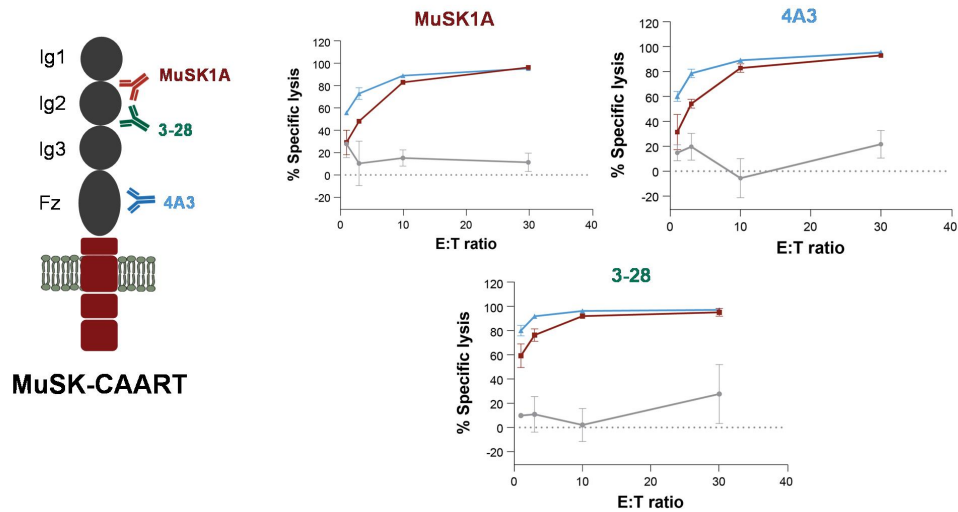
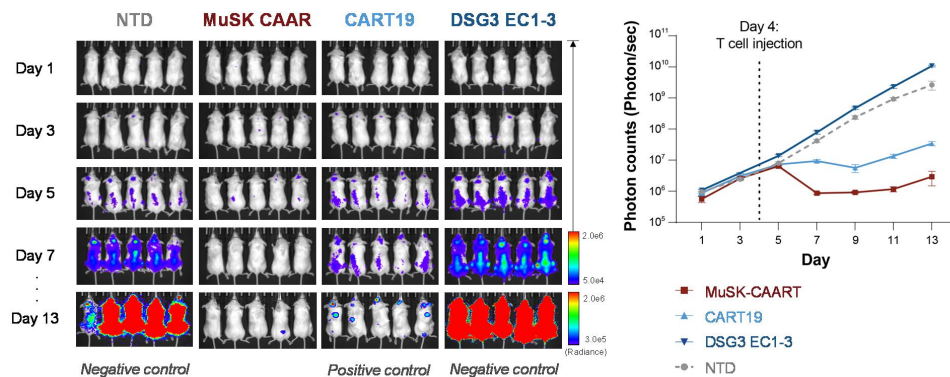


Figure illustrating that MuSK-CAART, which contains the native MuSK extracellular domain, demonstrated selective and specific *in vitro* cytotoxicity towards a B cell line expressing anti-MuSK antibodies targeting different MuSK epitopes across multiple domains of the native MuSK protein. The specific lysis increases directly with increasing effector to target ratios for MuSK-CAART.

As illustrated in the figure below, in an *in vivo* mouse model, MuSK CAAR T cells, but not control CAAR T cells, showed biological activity by blocking the growth of B cell lines expressing an anti-MuSK antibody.



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Figure illustrating MuSK CAAR T cells are able to recognize and suppress anti-MuSK target cells in a murine model. The target cells express both CD19 and anti-MuSK B cell receptors, and CART19 is used as a positive control in this experimental system.

Based in part on these results, IND-enabling studies were initiated for the MuSK-CAART product candidate. An IND submission is anticipated in the second half of 2021 for MuSK-CAART.

FVIII-CAART for Hemophilia A with Factor VIII Alloantibodies

While our CABA platform is primarily directed towards the treatment of B cell-mediated autoimmune diseases, we believe the approach may be applicable in other instances where B cell antibody production is implicated. Specifically, we have identified an opportunity to apply the CABA platform to develop potential CAAR adjunctive therapies in cases where the immune system has or produces antibodies against potential therapies, which is known as an alloimmune response. These alloantibodies can prevent a particular therapy from being delivered effectively because the therapy is degraded by the immune response due to alloantibody binding. We believe our approach has the potential to address the alloantibody response by specifically ablating the B cells responsible for producing the alloantibodies through a similar mechanism seen in autoimmune disease. With the alloantibody producing cells ablated, the treatment could then be provided.

Scientific, Clinical and Commercial Assessment

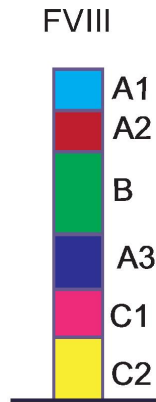
Hemophilia A is an X-linked bleeding disorder caused by mutations in the FVIII gene resulting in a deficiency of functional FVIII, a critical factor in blood coagulation. It affects about 1:5,000 male births. Severe Hemophilia A, where FVIII levels are less than 1% of normal, accounts for about 60% of all cases and is characterized by frequent spontaneous bleeds. Currently, Hemophilia A is treated with FVIII replacement via intravenous administration.

The main complication of FVIII replacement therapy is that 20% to 30% of patients with severe disease develop neutralizing alloantibodies against the FVIII protein. These alloantibodies decrease the levels of FVIII and at high titers, render attempts to replace or stimulate the production of FVIII ineffective. The risk of alloantibody development for patients with severe Hemophilia A is highest during their initial FVIII exposures. The standard treatment to reverse alloantibody formation consists of repeated high-dose infusions of FVIII, which has limited efficacy, a high cost and is difficult to titrate to an appropriate therapeutic level for the patient. We believe FVIII-

CAART could be effective in addressing patients with Hemophilia A who have developed FVIII antibodies that require repeated, high-dose administrations of FVIII.

Epitope Mapping

The following image depicts FVIII, which is a large glycoprotein consisting of six domains that interact with each other to form the full complex.



Studies conducted in patients with Hemophilia A have revealed that acquired FVIII alloantibodies following exogenous FVIII administration are typically directed against A2, C1 and C2 domains of FVIII.

CAAR Construct and Design

Preliminary FVIII CAAR and CAAR-like constructs have been engineered that target parts, but not all, of the FVIII domains. Dr. Milone, one of our scientific co-founders, has led the development of one such construct.

Development Plan

Internally, we are conducting additional studies to optimize our FVIII-CAART development. The focus of these studies will be to fully characterize any additional pathogenic epitopes and construct a FVIII-CAART that includes additional FVIII domains. Given the size of the FVIII protein, this will likely require us to incorporate additional technologies to reduce the size of the final CAAR construct. An evaluation of potential technologies to achieve this objective is ongoing.

Manufacturing

Manufacturing Strategy

We intend to implement a three-stage plan that we believe will ultimately enable us to achieve manufacturing independence. Part of our strategy relies on engaging non-profit and commercial suppliers early and in a staged manner. We believe partnering with proven and reputable manufacturing partners will allow us to efficiently deploy financial and personnel resources. Stage 1 of this plan is in place and utilizes the deep expertise in cell and vector manufacturing from our partners at Children’s Hospital of Philadelphia, or CHOP, and Penn. This included early development work, support of the DSG3-CAART IND, and cell and vector product manufacturing for our DesCAARTes™ trial. We believe these facilities will allow us to move efficiently into clinical trials but are not sufficient to support a commercial license.

Stage 2 of our plan is designed to engage partners who are qualified for manufacturing of vector at commercial grade and scale and cell therapy products. We are aware that changes in any manufacturing process or facility introduces regulatory and scientific risk to a development program, if the changes result in a product that is not comparable. We plan to mitigate these risks primarily in two ways:

1. *By securing contract manufacturing organizations, or CMOs, as partners during Stage 2 of our manufacturing strategy early on for both vector and cell manufacturing.* We plan to prioritize potential partners who are qualified to, and have an established track record of, the commercial production of vector and cell products. We believe this allows us to make one change in our supply partners during an early period of clinical development to facilitate *in vitro* comparability testing and clinical validation, prior to controlled clinical studies.
2. *By licensing the cell manufacturing process used for our planned Phase 1 DSG3-CAART first-in-human study from Penn.* This is allowing us the time to understand the process used in order to reduce the chance of changes that may impact comparability.

In addition to Stage 2, and contingent on sufficient clinical evidence from our planned DesCAARTes™ trial, we are further planning to pursue Stage 3 in manufacturing supply. During Stage 3, we plan to build, qualify and run our own manufacturing facility. We believe this additional stage will enable full control of continuous improvement, product development and commercial supply for products arising from our CABA platform. Our Chief Executive Officer and Executive Vice President, Science and Technology have both, in prior roles, built and led organizations that have constructed and commissioned cell therapy facilities.

Vector Manufacturing

The lentiviral vector that we plan to use in the initial subjects in our DesCAARTes™ trial was manufactured at CHOP. We have also reserved multiple vector manufacturing slots at Penn and CHOP, which we may use in our DSG3-CAART or subsequent clinical trials. In parallel, we are engaging in development work with multiple CMOs with a plan to secure production slots for vector which may be used in our DSG3-CAART or subsequent clinical trials. We believe these efforts will provide us with sufficient clinical-grade vector to move forward with our anticipated clinical trials.

Cell Manufacturing

We have entered into a collaboration with the Clinical Cell and Vaccine Production Facility, or CVPF, at Penn, to provide focused scientific, technical and regulatory support for CAAR T cell manufacture. CVPF is accredited by the Foundation for the Accreditation of Cellular Therapy and is capable of and experienced at supporting manufacture for early-phase clinical trials of novel cell therapy products in first-in-man clinical trials. We expect to rely upon CVPF to provide initial Phase 1 clinical trial drug supply for DSG3-CAART. Penn's manufacturing process for DSG3-CAART is directly related to the process developed at Penn for early clinical trials of CART19, which subsequently became known commercially as Kymriah. The process was later transferred to Novartis Pharmaceuticals Corporation and further modified for the Kymriah program.

As we scale our manufacturing of DSG3-CAART and our other product candidates to meet our expected needs for further clinical trials, we may or may not rely on Penn, but we also expect to rely on CMOs and other third parties for the manufacturing and processing of our clinical trial materials. Any CMO that we select will be subject to cGMP requirements. We believe the use of contract manufacturing for our pipeline programs will be cost-effective and allow us to rapidly prepare for clinical trials in accordance with our development plans. In preparation for this transition, we have engaged multiple third-party contractors to manufacture clinical grade viral vector used to deliver the applicable CAAR gene into the T cells. We have also initiated development work with certain contractors for cGMP and commercial vector production. We expect third-party manufacturers will be capable of providing and processing sufficient quantities of our product candidates to meet anticipated clinical trial demands and commercial need. In January 2021, we initiated a collaboration with WuXi to serve as our cell processing manufacturing partner for the anticipated MuSK-CAART Phase 1 clinical trial.

Once we have sufficient clinical data from subjects in our DSG3-CAART study, we intend to begin the process of engineering and then establishing our own commercial scale GMP-compliant manufacturing facility. We believe this will allow us to enhance supply chain control, increase supply capacity and help ensure clinical and commercial demand for our pipeline programs is met in the event that DSG3-CAART receives marketing approval. Informed by our experience in building cell therapy facilities and creating supply chains, we plan to develop a robust supply chain with alternative sources to maintain continuous supply. In parallel with these activities, we are evaluating and executing proof-of-concept studies to test advanced manufacturing and automation technologies to continuously improve the manufacturing process and meet commercial and scalability targets.

Commercialization

Our aim is to become a fully integrated cellular therapy company in order to improve the lives of patients with B cell-mediated autoimmune diseases. We have designed a strategic approach to move forward with our lead product candidate, DSG3-CAART, while at the same time having a number of product candidates in development. The product candidates from our CABA platform address clinical indications where there is a compelling opportunity to improve clinical outcomes in comparison with the current standard of care in an easily identified patient population. Our initial product candidates are focused on rare disease populations where we believe there is potential to commercialize independently. This is due to a concentration of treatment paradigms and limited but easily identified patient populations. Our plan is to focus commercialization and launch efforts initially in the United States, and eventually in the European Union and Asia-Pacific geographies.

Competition

The biotechnology and pharmaceutical industries are characterized by rapidly advancing technologies, intense competition and a strong focus on intellectual property. We face competition from many different players, including large and specialty pharmaceutical and biotechnology companies, academic research organizations and governmental agencies. Any therapeutic candidates we successfully develop and commercialize will compete with the existing standard of care as well as any novel therapies that may gain regulatory approval in the future.

Existing treatment options for PV are limited. Rituximab, marketed by Roche Holding AG, is the first drug to have received approval for PV in the United States in over 60 years. In Europe, the approved therapies for PV are corticosteroids, azathioprine and rituximab. Other standard of care treatments include various immunosuppressants, plasmapheresis, and intravenous immunoglobulin infusions given monthly or on another periodic chronic basis. Additionally, multiple biopharmaceutical companies have therapies in clinical development.

Competition in the MuSK MG autoimmune space is currently dominated by the current standard of care, rituximab. A second approved approach to treating patients is IVIG, which is available through CSL Behring LLC, Grifols, S.A., and Mitsubishi Tanabe Pharma Corporation. Additionally, multiple biopharmaceutical companies have therapies in clinical development.

Multiple therapies are approved or in development for the treatment of Hemophilia A patients who develop alloantibodies against FVIII. Standard of care is typically immune tolerance induction, or ITI, therapy with higher doses of FVIII. Available treatments for those who do not respond to ITI include anti-inhibitor coagulation complexes, recombinant factor VIIa, and bispecific factor IXa- and factor X-directed antibodies. Companies who market products or are developing product candidates within these categories of medicine include Catalyst Pharmaceuticals, Inc., Novo Nordisk A/S, OPKO Health, Inc., Roche Holding AG and Takeda Pharmaceutical Company.

We believe we are the first and only company developing CAAR T drug candidates for the treatment of B cell-mediated autoimmune diseases. However, despite the significant differences in discovery, development and target populations between oncology and autoimmune targets, we recognize that companies with an investment and expertise in CAR T cell development for oncology indications could attempt to leverage their expertise into B cell-mediated autoimmune disease-affected populations. We are aware of biotechnology companies that are exploring other methods of engineering T cells for the treatment of autoimmune conditions. In addition, some biotechnology companies are engineering red blood cells to incorporate self-antigens with the goal of tolerizing the immune system to treat autoimmune and alloimmune conditions.

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 industry 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 collaborative arrangements with large and established companies. 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.

Intellectual Property and Barriers to Entry

We strive to protect the proprietary technologies that we believe are important to our business, including pursuing and maintaining patent protection intended to cover our product candidates and their use, as well as other inventions that are important to our business. In addition to patent protection, we also rely on know-how, confidentiality agreements, invention assignment agreements and trade secrets to protect aspects of our business that are not amenable to, or that we do not consider appropriate for, patent protection, to develop and maintain our proprietary position. The confidentiality agreements are designed to protect our proprietary information and the invention assignment agreements are designed to grant us ownership of technologies that are developed for us by our employees, consultants or certain other third parties. We seek to preserve the integrity and confidentiality of our data and trade secrets by maintaining physical security of our premises and physical and electronic security of our information technology systems. While we have confidence in our agreements and security measures, either may be breached, and we may not have adequate remedies. In addition, our trade secrets may otherwise become known or independently discovered by competitors.

Our commercial success depends in part upon our ability to obtain and maintain patent and other proprietary protection for commercially important technologies, inventions and trade secrets related to our business, defend and enforce our intellectual property rights, particularly our patent rights, preserve the confidentiality of our trade secrets and operate without infringing valid and enforceable intellectual property rights of others.

The patent positions for biotechnology companies like us are generally uncertain and can involve complex legal, scientific and factual issues. In addition, the coverage claimed in a patent application can be significantly reduced before a patent is issued, and its scope can be reinterpreted and even challenged after issuance. As a result, we cannot guarantee that any of our product candidates will be protectable or remain protected by enforceable patents. We cannot predict whether the patent applications we are currently pursuing will issue as patents in any particular jurisdiction or whether the claims of any issued patents will provide sufficient proprietary protection from competitors. Any patents that we hold may be challenged, circumvented or invalidated by third parties.

As of February 1, 2021, our patent estate (all of which has been in-licensed) included one issued U.S. patent, seven pending U.S. patent applications, and 34 pending foreign patent applications. See “—Our Material Agreements—Amended and Restated License Agreement with the Trustees of the University of Pennsylvania and the Children’s Hospital of Philadelphia.”

With regard to our DSG3-CAART and DSG3/1-CAART product candidates, we have one issued U.S. patent with claims directed to a genetically modified cell containing a chimeric autoantibody receptor containing an extracellular domain containing DSG3, DSG1 or fragments thereof, which is scheduled to expire in 2035, without taking a potential patent term extension into account. We also have four pending U.S. patent applications and

counterpart patent applications pending in Canada, China and Europe, which if issued, would be expected to expire in 2035. This patent family is owned by Penn and exclusively licensed to us in the field of the license.

With regard to our MuSK-CAAR T cell product candidate, we have one pending U.S. patent application and counterpart patent applications pending in Australia, Canada, China, Europe, Israel, Japan, Korea, Mexico, New Zealand, and Russia, which if issued, would be expected to expire in 2039. This patent family is owned by Penn and exclusively licensed to us in the field of the license.

With regard to our FVIII-CAAR T cell product candidate, we have one pending U.S. patent application and counterpart patent applications pending in Australia, Canada, China, Europe, Japan, Hong Kong, Korea, Mexico, New Zealand, and Russia, which if issued, would be expected to expire in 2037. This patent family is co-owned by Penn and CHOP and is exclusively licensed to us in the field of the license.

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 earliest date of filing a non-provisional patent application.

In the United States, the term of a patent covering an FDA-approved drug may be eligible for a patent term extension under the Hatch-Waxman Act as compensation for the loss of patent term during the FDA regulatory review process. The period of extension may be up to five years beyond the expiration of the patent, but cannot extend the remaining term of a patent beyond a total of 14 years from the date of product approval. Only one patent among those eligible for an extension may be extended, and a given patent may only be extended once. Similar provisions are available in Europe and in certain other jurisdictions to extend the term of a patent that covers an approved drug. It is possible that issued U.S. patents covering each of our product candidates may be entitled to patent term extensions. If our product candidates receive FDA approval, we intend to apply for patent term extensions, if available, to extend the term of patents that cover the approved product candidates. We also intend to seek patent term extensions in any jurisdictions where they are available, however, there is no guarantee that the applicable authorities, including the FDA, will agree with our assessment of whether such extensions should be granted, and even if granted, the length of such extensions.

In addition to patent protection, we also rely on know-how and trade secret protection for our proprietary information that is not amenable to, or that we do not consider appropriate for, patent protection, to develop and maintain our proprietary position. However, trade secrets can be difficult to protect. Although we take steps to protect our proprietary information, including restricting access to our premises and our confidential information, as well as entering into agreements with our employees, consultants, advisors and potential collaborators, third parties may independently develop the same or similar proprietary information or may otherwise gain access to our proprietary information. As a result, we may be unable to meaningfully protect our know-how, trade secrets, and other proprietary information.

In addition, we plan to rely on regulatory protection based on orphan drug exclusivities, data exclusivities, and market exclusivities. See “—Government Regulation” for additional information.

Our Material Agreements

Amended and Restated License Agreement with the Trustees of the University of Pennsylvania and the Children’s Hospital of Philadelphia

In July 2019, we entered into an amended and restated license agreement, or the License Agreement, as further amended in May 2020, with Penn and CHOP, collectively the Institutions, pursuant to which we obtained (a) a non-exclusive, non-sublicensable, worldwide research license to make, have made and use products in two subfields of use, (b) effective as of October 2018, an exclusive, worldwide, royalty-bearing license, with the right to sublicense, under certain patent rights of the Institution to make, use, sell, offer for sale and import products in the same two subfields of use, and (c) effective as of October 2018, a non-exclusive, worldwide, royalty-bearing license, with limited rights to sublicense, under certain of Penn’s know-how, which know-how satisfies certain criteria and is listed on a mutually agreed-to schedule, to make, have made, use, sell, offer for sale, import and have imported products in the same two subfields of use. Our rights are subject to the rights of the U.S. government and certain

rights retained by the Institutions. The License Agreement was amended in May 2020 to add certain intellectual property relating to one of the three undisclosed disease targets.

Unless earlier terminated, the License Agreement expires on the expiration or abandonment or other termination of the last valid claim in the intellectual property we license from Penn. We may terminate the License Agreement at any time for convenience upon 60 days written notice. In the event of an uncured, material breach, Penn may terminate the License Agreement upon 60 days written notice.

Penn maintains control of all filing, prosecution and maintenance of the Institutions' patent rights licensed by us, and we are responsible for all ongoing patent costs during the term of the agreement. We also reimbursed Penn for its out-of-pocket expenses incurred prior to the effective date of the agreement with respect to the filing, prosecution and maintenance of the patent rights licensed by us. Under the terms of the License Agreement, we were also obligated to pay \$2.0 million annually for three years beginning August 2018 for funding to the laboratories of each of Drs. Milone and Payne. See "—Sponsored Research Agreements with the Trustees of the University of Pennsylvania."

Under the License Agreement, we must use commercially reasonable efforts to develop and commercialize a product in each subfield. During the term of the License Agreement until the first commercial sale of the first product, we are obligated to pay Penn a non-refundable, non-creditable annual license maintenance fee of \$10,000. We are required to pay certain milestone payments upon the achievement of specified clinical and commercial milestones. Milestone payments are reduced by a certain percentage for the second product that achieves a milestone, by an additional percentage for the third product that achieves a milestone, and so on, for each subsequent product that achieves a milestone. In the event that we are able to successfully develop and launch multiple products under the License Agreement, total milestone payments could be approximately \$21.0 million. Penn is also eligible to receive tiered royalties at percentage rates in the low single-digits, subject to an annual minimum royalty, on annual worldwide net sales of any products that are commercialized by us, our affiliates or our sublicensees that contain, use, embody, result from the use of or incorporate, or are covered by, the intellectual property licensed by us. To the extent we sublicense our license rights under the License Agreement, Penn would be eligible to receive tiered sublicense income at percentage rates in the mid-single to low double-digits. We have also entered into a subscription and technology transfer agreement with Penn, pursuant to which we owed Penn an upfront subscription fee, which was paid in 2019, and a nominal non-refundable royalty on the net sales of products, a portion of which will be credited toward milestone payments and royalties under this License Agreement. Technology transfer activities would be at our cost and subject to agreement as to the technology to be transferred.

Sponsored Research Agreements with Penn

Dr. Michael Milone

In April 2018, we entered into a Sponsored Research Agreement with Penn for the laboratory of Dr. Milone, or the Milone SRA, pursuant to which we agreed to sponsor certain research related to the development of (i) T cell based immunotherapies for autoimmune and alloimmune antibodies of pathologic significance and (ii) a clinical grade microfluidic device designed for single step selection and activation of T cells from blood samples to be conducted in Dr. Milone's laboratory at Penn. Under the Milone SRA, Penn granted us a perpetual, irrevocable, non-transferable, non-exclusive license to use all intellectual property resulting from the research sponsored by us for internal research purposes. In addition, Penn granted us an option to include, in exchange for a fee, any intellectual property resulting from the research sponsored by us that relates to CAAR T cell therapies for hemophilia and/or pemphigus within the scope of the License Agreement. Penn also granted us an option to negotiate a license to all other intellectual property resulting from the research sponsored by us. Unless earlier terminated, the Milone SRA will expire on April 23, 2021.

Dr. Aimee Payne

In April 2018, we entered into a Sponsored Research Agreement with Penn for the laboratory of Dr. Payne, or the Payne SRA, pursuant to which we agreed to sponsor certain research related to the development of T cell based immunotherapies for autoimmune and alloimmune antibodies of pathologic significance to be conducted in Dr. Payne's laboratory at Penn. In May 2020, the Payne SRA was amended to include CAAR design and optimization efforts in three additional B cell-mediated autoimmune diseases. In August 2020, this agreement was further amended to extend the term of the original research plan. Under the Payne SRA, Penn granted us a perpetual, irrevocable, non-transferable, non-exclusive license to use all intellectual property resulting from the research sponsored by us for internal research purposes. In addition, Penn granted us an option to include, in exchange for a fee, any intellectual property resulting from the research sponsored by us that relates to CAAR T cell therapies for

hemophilia, MG and/or pemphigus within the scope of the License Agreement. Penn also granted us an option to negotiate a license to all other intellectual property resulting from the research sponsored by us. Unless earlier terminated, the Payne SRA will expire in February 2023.

We have committed to funding a defined research plan for through February 2023 under both the Milone and Payne SRAs. We have estimated the total cost of the two SRAs to be \$11.8 million, which satisfies the \$2.0 million annual obligation under the License Agreement. As of December 31, 2020, \$7.1 million of cost has been incurred pursuant to the Milone and Payne SRAs.

Master Translational Research Services Agreement with Penn

In October 2018, we entered into a Master Translational Research Services Agreement with Penn, or the Services Agreement, pursuant to which Penn agreed to perform certain services related to the research and development of the technology licensed to us under the License Agreement, as well as certain clinical, regulatory and manufacturing services. The Services Agreement will expire on the later of (i) October 19, 2021 or (ii) completion of the services for which we have engaged Penn under the Services Agreement. Either party may terminate this agreement with or without cause upon a certain number of days' prior written notice. The services encompassed by the Services Agreement are performed by different organizations at Penn pursuant to certain addenda to the Services Agreement, including the Center for Advanced Retinal and Ocular Therapeutics, or CAROT, Addendum, as amended in May 2020, and the CVPF Addendum. In addition, in July 2019 we entered into an Alliance Agreement with Penn, pursuant to which we will pay Penn a nominal annual fee in order for Penn to provide an adequate and consistent level of support to the services that it provides to us.

The CAROT Addendum

Under the CAROT Addendum, Penn manufactures vector that is then to be used by the CVPF in the manufacture of our product candidates. In the event that certain materials owned by Penn are incorporated into a product developed for us, Penn has agreed to grant us a limited license to use those materials. Further, Penn agreed to grant us an exclusive, paid-up, royalty-free, transferable, irrevocable, perpetual exclusive license to any deliverables produced under the CAROT Addendum, except with respect to certain technical information of Penn that is contained or incorporated in the deliverables, to which Penn agreed to grant us a limited nonexclusive license. However, any necessary technology transfer would be pursuant to the subscription and technology transfer agreement described above.

The CVPF Addendum

Under the CVPF Addendum, Penn conducts process validation studies and large-scale engineering runs for our product candidates. Under the CVPF Addendum, CVPF will contractually agree to manufacture agreed upon quantities of DSG3-CAART material for use in connection with our DesCAARTes™ trial, unless the agreement is terminated by either party. Any necessary technology transfer would be pursuant to the subscription and technology transfer agreement described above.

Research Agreements with The Regents of the University of California

In October 2018, we entered into the first Research Agreement, or the First UC Agreement, with The Regents of the University of California, or the UC Regents, pursuant to which the UC Regents agreed to perform certain research projects relating to the toxicity and activity of MuSK CAAR T cells in various models of anti-MuSK MG, or the UC Research. In January 2021, we entered into the Second Research Agreement, or the Second UC Agreement, collectively, the UC Agreements, pursuant to which the UC Regents agreed to perform the same.

The UC Agreements provide that the UC Regents will own all rights to any intellectual property developed solely by UC Regents employees in conducting the UC Research, or developed solely by any of our employees that conduct the UC Research using the UC Regents' facilities or resources. The UC Regents granted us an irrevocable, royalty-free, nonexclusive, worldwide, nontransferable, perpetual license to use this UC-owned intellectual property for internal research purposes only.

We and the UC Regents jointly own the rights to any intellectual property jointly developed by our employees and UC Regents employees in conducting the UC Research, provided that our employees did not use the UC Regents' facilities or resources in the research. We were granted an option to acquire a non-exclusive or exclusive, worldwide, transferable license, including the right to sublicense, to make, use sell, offer for sale, import and otherwise exploit products embodying these joint inventions.

If we exercise our option with respect to certain intellectual property under the UC Agreements, any license we enter into will require us to diligently pursue timely commercial development and marketing of product candidates using such intellectual property, and will be subject to other terms and conditions to be negotiated at the time of entering into any such license. Unless earlier terminated, the term of the First UC Agreement will expire in January 2022. Unless earlier terminated, the term of the Second UC Agreement will expire in 2023.

Government Regulation

U.S. Regulation

As a biopharmaceutical company that operates in the United States, we are subject to extensive regulation. Our cell products will be regulated as biologics. With this classification, commercial production of our products will need to occur in registered facilities in compliance with cGMP for biologics. The FDA categorizes human cell- or tissue-based products as either minimally manipulated or more than minimally manipulated, and has determined that more than minimally manipulated products require clinical trials to demonstrate product safety and efficacy and the submission of a BLA for marketing authorization. Our products are considered more than minimally manipulated and will require evaluation in clinical trials and the submission and approval of a BLA before we can market them.

Government authorities in the United States (at the federal, state and local level) and in other countries extensively regulate, among other things, the research, development, testing, manufacturing, quality control, approval, labeling, packaging, storage, record-keeping, promotion, advertising, distribution, post-approval monitoring and reporting, marketing and export and import of biopharmaceutical products such as those we are developing. Our product candidates must be approved by the FDA before they may be legally marketed in the United States and by the appropriate foreign regulatory agency before they may be legally marketed in foreign countries. Generally, our activities in other countries will be subject to regulation that is similar in nature and scope as that imposed in the United States, although there can be important differences. Additionally, some significant aspects of regulation in Europe are addressed in a centralized way, but country-specific regulation remains essential in many respects. The process for obtaining regulatory marketing approvals and the subsequent compliance with appropriate federal, state, local and foreign statutes and regulations require the expenditure of substantial time and financial resources.

U.S. Biological Product Development

In the United States, the FDA regulates biologics under the Federal Food, Drug, and Cosmetic Act, or FDCA, and the Public Health Service Act, or PHSA, and their implementing regulations. Biologics are also subject to other federal, state and local statutes and regulations. The process of obtaining regulatory approvals and the subsequent compliance with appropriate federal, state, local and foreign statutes and regulations require the expenditure of substantial time and financial resources. Failure to comply with the applicable U.S. requirements at any time during the product development process, approval process or after approval, may result in delays to the conduct of a study, regulatory review and approval or subject an applicant to administrative or judicial sanctions. These sanctions could include, among other actions, the FDA's refusal to approve pending applications, withdrawal of an approval, license suspension or revocation, refusal to allow an applicant to proceed with clinical trials, imposition of a clinical hold, issuance of untitled or warning letters, product recalls or withdrawals from the market, product seizures, total or partial suspension of production or distribution, injunctions, fines, refusals of government contracts, restitution, disgorgement of profits, or civil or criminal investigations or penalties. Any agency or judicial enforcement action could have a material adverse effect on us.

Our drug product candidates must be approved by the FDA through the Biologics License Application, or BLA, process before they may be legally marketed in the United States. The process required by the FDA before a biologic may be marketed in the United States generally involves the following:

- completion of extensive nonclinical, sometimes referred to as preclinical, laboratory tests, animal studies and formulation studies in accordance with applicable regulations, including the FDA's Good Laboratory Practice, or GLP, regulations and standards;
- submission to the FDA of an IND which must become effective before human clinical trials may begin;
- approval by an independent institutional review board, or IRB, representing each clinical site before each clinical trial may be initiated;
- performance of adequate and well-controlled human clinical trials in accordance with applicable IND regulations, good clinical practices, or GCPs, and other clinical trial-related regulations to establish the safety and efficacy of the proposed drug product candidate for its proposed indication;
- submission to the FDA of a BLA, which includes not only the results of the clinical trials, but also, detailed information on the chemistry, manufacture and quality controls for the product candidate and proposed labeling;
- satisfactory completion of an FDA pre-approval inspection of the manufacturing facility or facilities where the product is produced to assess compliance with the FDA's current good manufacturing practice, or cGMP, requirements to assure that the facilities, methods and controls are adequate to preserve the product's identity, strength, quality, purity and potency;
- potential FDA audit of the preclinical trial sites and/or clinical trial sites that generated the data in support of the BLA; and
- FDA review and approval of the BLA prior to any commercial marketing or sale of the product in the United States.

The data required to support a BLA is generated in two distinct development stages: preclinical and clinical. The preclinical development stage generally involves laboratory evaluations of drug chemistry, formulation and stability, as well as studies to evaluate toxicity in animals, which support subsequent clinical testing. The conduct of the preclinical studies must comply with federal regulations, including GLPs. The sponsor must submit the results of the preclinical studies, together with manufacturing information, analytical data, any available clinical data or literature and a proposed clinical protocol, as well as other information, to the FDA as part of the IND. An IND is a request for authorization from the FDA to administer an investigational drug product to humans. The central focus of an IND submission is on the general investigational plan and the protocol(s) for human trials. The IND automatically becomes effective 30 days after receipt by the FDA, unless the FDA raises concerns or questions regarding the proposed clinical trials and places the IND on 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 trial can begin. The FDA may also impose clinical holds on a drug product candidate at any time before or during clinical trials due to safety concerns, non-compliance, or other issues affecting the integrity of the trial. Accordingly, we cannot be sure that submission of an IND will result in the FDA allowing clinical trials to begin, or that, once begun, issues will not arise that could cause the trial to be suspended or terminated.

In addition to the submission of an IND to the FDA before initiation of a clinical trial in the United States, certain human clinical trials involving recombinant or synthetic nucleic acid molecules had historically been subject to review by the Recombinant DNA Advisory Committee, or RAC, of the NIH Office of Biotechnology Activities, or the NIH Office of Biotechnology Activities, or OBA, pursuant to the NIH Guidelines. On August 17, 2018, the NIH issued a notice in the Federal Register and issued a public statement proposing changes to the oversight framework for gene therapy trials, including changes to the applicable NIH Guidelines to modify the roles and responsibilities of the RAC with respect to human clinical trials of gene therapy products, and requesting public comment on its proposed modifications. During the public comment period, which closed October 16, 2018, the NIH announced that it will no longer accept new human gene transfer protocols for review as a part of the protocol registration process or convene the RAC to review individual clinical protocols. In April 2019, NIH announced the updated guidelines, which reflect these proposed changes, and clarify that these trials will remain subject to the FDA's oversight and other clinical trial regulations, and oversight at the local level will continue as set forth in the NIH Guidelines. Specifically, under the NIH Guidelines, supervision of human gene transfer trials includes evaluation and assessment by an Institutional Biosafety Committee, or IBC, a local institutional committee that reviews and oversees research utilizing recombinant or synthetic nucleic acid molecules at that institution. The IBC assesses the safety of the research and identifies any potential risk to public health or the environment, and such review may result in some delay before initiation of a clinical trial. While the NIH Guidelines are not mandatory unless the research in question is being conducted at or sponsored by institutions receiving NIH funding of recombinant or synthetic nucleic acid molecule research, many companies and other institutions not otherwise subject to the NIH Guidelines voluntarily follow them.

The clinical stage of development involves the administration of the drug product candidate to healthy volunteers and patients under the supervision of qualified investigators, generally physicians not employed by or under the trial sponsor's control, in accordance with GCPs, which include the requirement that all research subjects provide their informed consent for their participation in any clinical trial. Clinical trials are conducted under protocols detailing, among other things, the objectives of the clinical trial, dosing procedures, subject selection and exclusion criteria, and the parameters to be used to monitor subject safety and assess efficacy. Each protocol, and any subsequent amendments to the protocol, must be submitted to the FDA as part of the IND. Further, each clinical trial must be reviewed and approved by an IRB at or servicing each institution at which the clinical trial will be conducted. An IRB is charged with protecting the welfare and rights of trial participants and considers such items as whether the risks to individuals participating in the clinical trials are minimized and are reasonable in relation to anticipated benefits. The IRB also approves the informed consent form that must be provided to each clinical trial subject or his or her legal representative and must monitor the clinical trial until completed.

There are also requirements governing the reporting of ongoing clinical trials and completed clinical trial results to public registries. Sponsors of certain clinical trials of FDA-regulated products, including biologics, are required to register and disclose certain clinical trial information, which is publicly available at www.clinicaltrials.gov.

Clinical trials are generally conducted in three sequential phases, known as Phase 1, Phase 2 and Phase 3, and may overlap. Phase 1 clinical trials generally involve a small number of healthy volunteers who are initially exposed to a single dose and then multiple doses of the drug product candidate. The primary purpose of these clinical trials is to assess the metabolism, pharmacologic action tolerability, adverse effects, and safety of the drug product candidate and, if possible, to gain early evidence on effectiveness. Phase 2 clinical trials typically involve studies in disease-affected patients to determine the dose required to produce the desired benefits. At the same time, safety and further pharmacokinetic and pharmacodynamic information is collected, as well as identification of possible adverse effects and safety risks and preliminary evaluation of efficacy. Phase 3 clinical trials generally involve large numbers of patients at multiple sites, in multiple countries, and are designed to provide the data necessary to demonstrate the efficacy of the product for its intended use, its safety in use, and to establish the overall benefit/risk relationship of the product and provide an adequate basis for product approval. Phase 3 clinical trials may include comparisons with placebo and/or other comparator treatments. The duration of treatment is often extended to mimic the actual use of a product during marketing. Generally, two adequate and well-controlled Phase 3 clinical trials are required by the FDA for approval of a BLA. In certain instances, FDA may condition approval of a BLA on the sponsor's agreement to conduct additional clinical trials to further assess the biologic's safety and effectiveness after BLA approval. Such post-approval trials are sometimes referred to as Phase 4 clinical trials. These trials are used to gain additional experience from the treatment of patients in the intended therapeutic indication and further document clinical benefit in the case of drugs approved under Accelerated Approval regulations. Failure to exhibit due diligence with regard to conducting Phase 4 clinical trials could result in withdrawal of approval for products.

Progress reports detailing the results of the clinical trials, among other information, must be submitted at least annually to the FDA, and written IND safety reports must be submitted to the FDA and the investigators for serious and unexpected suspected adverse events, findings from other studies suggesting a significant risk to humans exposed to the biologic, findings from animal or in vitro testing that suggest a significant risk for human subjects, and any clinically important increase in the rate of a serious suspected adverse reaction over that listed in the protocol or investigator brochure. Phase 1, Phase 2 and Phase 3 clinical trials may not be completed successfully within any specified period, if at all. The FDA, the IRB, or the sponsor may suspend or terminate a clinical trial at any time on various grounds, including a finding that the research subjects or patients are being exposed to an unacceptable health risk. Similarly, an IRB can suspend or terminate approval of a clinical trial at its institution if the clinical trial is not being conducted in accordance with the IRB's requirements or if the drug has been associated with unexpected serious harm to patients. Additionally, some clinical trials are overseen by an independent group of qualified experts organized by the clinical trial sponsor, known as a data safety monitoring board or committee. This group provides authorization for whether or not a trial may move forward at designated intervals based on access to certain data from the trial and may halt the clinical trial if it determines that there is an unacceptable safety risk for subjects or other grounds, such as interim data suggesting a lack of efficacy. We may also suspend or terminate a clinical trial based on evolving business objectives and/or competitive climate. Concurrent with clinical trials, companies usually complete additional animal studies and must also develop additional information about the chemistry and physical characteristics of the drug product candidate as well as finalize a process for manufacturing the product in commercial quantities in accordance with cGMP requirements. The manufacturing process must be capable of consistently producing quality batches of the drug product candidate and, among other things, must develop methods for testing the identity, strength, quality, potency and purity of the final product. Additionally,

appropriate packaging must be selected and tested and stability studies must be conducted to demonstrate that the drug product candidate does not undergo unacceptable deterioration over its shelf life.

BLA and FDA Review Process

Following trial completion, trial data are analyzed to assess safety and efficacy. The results of preclinical studies and clinical trials are then submitted to the FDA as part of a BLA, along with proposed labeling for the product and information about the manufacturing process and facilities that will be used to ensure product quality, results of analytical testing conducted on the chemistry of the drug product candidate, and other relevant information. The BLA is a request for approval to market the biologic for one or more specified indications and must contain proof of safety, purity, potency and efficacy, which is demonstrated by extensive preclinical and clinical testing. The application may include both negative or ambiguous results of preclinical and clinical trials as well as positive findings. Data may come from company-sponsored clinical trials intended to test the safety and efficacy of a use of a product, or from a number of alternative sources, including studies initiated by investigators. To support marketing approval, the data submitted must be sufficient in quality and quantity to establish the safety and efficacy of the investigational product to the satisfaction of the FDA. FDA approval of a BLA must be obtained before a biologic may be marketed in the United States.

Under the Prescription Drug User Fee Act, or PDUFA, as amended, each BLA must be accompanied by a significant user fee, which is adjusted on an annual basis. PDUFA also imposes an annual prescription drug product program fee. 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.

Once a BLA has been accepted for filing, which occurs, if at all, sixty days after the BLA's submission, the FDA's goal is to review BLAs within 10 months of the filing date for standard review or six months of the filing date for priority review, if the application is for a product intended for a serious or life-threatening condition and the product, if approved, would provide a significant improvement in safety or effectiveness. The FDA has substantial discretion in the approval process and may refuse to accept any application or decide that the data is insufficient for approval, and may require additional preclinical, clinical or other studies before it accepts the filing. Additionally, the review process is often significantly extended by FDA requests for additional information or clarification.

After the BLA submission is accepted for filing, the FDA reviews the BLA to determine, among other things, whether the proposed drug product candidate is safe and effective for its intended use, and whether the drug product candidate is being manufactured in accordance with cGMP to assure and preserve the drug product candidate's identity, strength, quality, purity and potency. The FDA may refer applications for novel drug product candidates or drug product candidates which 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. The FDA will likely re-analyze the clinical trial data, which could result in extensive discussions between the FDA and us during the review process. The review and evaluation of a BLA by the FDA is extensive and time consuming and may take longer than originally planned to complete, and we may not receive a timely approval, if at all.

Before approving a BLA, the FDA will conduct a pre-approval inspection of the manufacturing facilities for the new product to determine whether the facilities comply with cGMPs. The FDA will not approve the product unless it determines that the manufacturing processes and facilities are in compliance with cGMP requirements and adequate to assure consistent production of the product within required specifications. In addition, before approving a BLA, the FDA may also audit data from clinical trials to ensure compliance with GCP requirements. After the FDA evaluates the application, manufacturing process and manufacturing facilities, it may issue an approval letter or a Complete Response Letter. An approval letter authorizes commercial marketing of the product with specific prescribing information for specific indications. A Complete Response Letter indicates that the review cycle of the application is complete and the application will not be approved in its present form. A Complete Response Letter usually describes all of the specific deficiencies in the BLA identified by the FDA. The Complete Response Letter may require additional clinical data and/or an additional pivotal Phase 3 clinical trial(s), and/or other significant and time-consuming requirements related to clinical trials, preclinical studies or manufacturing. If a Complete Response Letter is issued, the applicant may either resubmit the BLA, addressing all of the deficiencies identified in the letter, withdraw the application or request a hearing. Even if such data and information is submitted, the FDA may

ultimately decide that the BLA does not satisfy the criteria for approval. Data obtained from clinical trials are not always conclusive, and the FDA may interpret data differently than we interpret the same data.

There is no assurance that the FDA will ultimately approve a product for marketing in the United States, and we may encounter significant difficulties or costs during the review process. If a product receives marketing approval, the approval may be significantly limited to specific populations, severities of allergies, 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 or may condition the approval of the BLA on other changes to the proposed labeling, development of adequate controls and specifications, or a commitment to conduct post-market testing or clinical trials and surveillance to monitor the effects of approved products. For example, the FDA may require Phase 4 testing which involves clinical trials designed to further assess the product's safety and effectiveness and may require testing and surveillance programs to monitor the safety of approved products that have been commercialized. The FDA may also place other conditions on approvals including the requirement for a Risk Evaluation and Mitigation Strategy, or REMS, to assure the safe use of the product. If the FDA concludes a REMS is needed, the sponsor of the BLA must submit a proposed REMS. The FDA will not approve the BLA without an approved REMS, if required. A REMS could include medication guides, physician communication plans, or elements to assure safe use, such as restricted distribution methods, patient registries and other risk minimization tools. Any of these limitations on approval or marketing could restrict the commercial promotion, distribution, prescription or dispensing of products. Product approvals may be withdrawn for non-compliance with regulatory standards or based on the results of post-market studies or surveillance programs. Additionally, post-approval, many types of changes to the approved product, such as adding new indications, changing manufacturing processes and adding labeling claims, are subject to further testing requirements and FDA review and approval. Such post-approval requirements can be costly and time-consuming and can affect the potential market and profitability of the product.

Orphan Designation and Exclusivity

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 United States, or more than 200,000 individuals in the United States and for which there is no reasonable expectation that the cost of developing and making the product available in the United States for this type of disease or condition will be recovered from sales of the product.

Orphan drug designation must be requested before submitting an NDA or BLA. After the FDA grants orphan drug designation, the identity of the therapeutic agent and its potential orphan use are disclosed publicly by the FDA. Orphan drug designation does not convey any advantage in or shorten the duration of the regulatory review and approval process.

If a product that has orphan drug designation subsequently receives the first FDA approval for the disease or condition for which it has such designation, the product is entitled to orphan drug exclusivity, which means that the FDA may not approve any other applications to market the same drug or biologic for the same indication for seven years from the date of such approval, except in limited circumstances, such as a showing of clinical superiority to the product with orphan exclusivity on the basis of greater effectiveness or safety or providing a major contribution to patient care or in instances of drug supply issues. Competitors, however, may receive approval of either a different product for the same indication or the same product for a different indication but that could be used off-label in the orphan indication. Orphan drug exclusivity also could block the approval of one of our products for seven years if a competitor obtains approval before we do for the same product, as defined by the FDA, for the same indication we are seeking approval, or if our product is determined to be contained within the scope of the competitor's product for the same indication or disease. If we pursue marketing approval for an indication broader than the orphan drug designation we have received, we may not be entitled to orphan drug exclusivity. Orphan drug status in the European Union has similar, but not identical, requirements and benefits.

Expedited Development and Review Programs

The FDA has a fast track program that is intended to expedite or facilitate the process for reviewing new drugs and biological products that meet certain criteria. Specifically, new drugs and biological products are eligible for fast track designation if they are intended to treat a serious or life-threatening condition and nonclinical or clinical data

demonstrate the potential to address unmet medical needs for the condition. Fasttrack designation applies to the combination of the product and the specific indication for which it is being studied. The sponsor of a new drug or biologic may request the FDA to designate the drug or biologic as a fast track product concurrently with, or at any time after, submission of an IND, and the FDA must determine if the product qualifies for fast track designation within 60 days of receipt of the sponsor's request. Under the fast track designation, the FDA may consider for review sections of the marketing application on a rolling basis before the complete application is submitted, if the sponsor provides a schedule for the submission of the sections of the application, the FDA agrees to accept sections of the application and determines that the schedule is acceptable, and the sponsor pays any required user fees upon submission of the first section of the application.

Any product submitted to the FDA for marketing, including under a fast track program, may be eligible for other types of FDA programs intended to expedite development and review, such as priority review and accelerated approval. Any product is eligible for priority review, or review within a six-month timeframe from the date a complete BLA is accepted for filing, if it has the potential to provide a significant improvement in safety and effectiveness compared to available therapies. The FDA will attempt to direct additional resources to the evaluation of an application for a new drug or biological product designated for priority review in an effort to facilitate the review.

Additionally, a product may be eligible for accelerated approval. An investigational drug may obtain accelerated approval if it treats a serious or life-threatening condition and generally provides a meaningful advantage over available therapies and demonstrates an effect on a surrogate endpoint that is reasonably likely to predict clinical benefit or on a clinical endpoint that can be measured earlier than irreversible morbidity or mortality, or IMM, that is reasonably likely to predict an effect on IMM or other clinical benefit. As a condition of approval, the FDA may require that a sponsor of a drug or biological product receiving accelerated approval perform adequate and well-controlled post-marketing clinical trials. If the FDA concludes that a drug shown to be effective can be safely used only if distribution or use is restricted, it will require such post-marketing restrictions as it deems necessary to assure safe use of the drug, such as:

- distribution restricted to certain facilities or physicians with special training or experience; or
- distribution conditioned on the performance of specified medical procedures.

The limitations imposed would be commensurate with the specific safety concerns presented by the product. In addition, the FDA currently requires as a condition for accelerated approval pre-approval of promotional materials, which could adversely impact the timing of the commercial launch of the product. Fast track designation, priority review and accelerated approval do not change the standards for approval but may expedite the development or approval process.

Breakthrough Designation

A product can be designated as a breakthrough therapy if it is intended to treat a serious or life-threatening condition and preliminary clinical evidence indicates that it may demonstrate substantial improvement over existing therapies on one or more clinically significant endpoints. A sponsor may request that a drug product candidate be designated as a breakthrough therapy concurrently with, or at any time after, the submission of an IND, and the FDA must determine if the drug product candidate qualifies for breakthrough therapy designation within 60 days of receipt of the sponsor's request. If so designated, the FDA shall act to expedite the development and review of the product's marketing application, including by meeting with the sponsor throughout the product's development, providing timely advice to the sponsor to ensure that the development program to gather preclinical and clinical data is as efficient as practicable, involving senior managers and experienced review staff in a cross-disciplinary review, assigning a cross-disciplinary project lead for the FDA review team to facilitate an efficient review of the development program and to serve as a scientific liaison between the review team and the sponsor, and taking steps to ensure that the design of the clinical trials is as efficient as practicable.

Accelerated Approval for Regenerative Medicine Advanced Therapies

As part of the 21st Century Cures Act, Congress amended the FDCA to create an accelerated approval program for regenerative advanced therapies, which include cell therapies, therapeutic tissue engineering products,

human cell and tissue products, and combination products using any such therapies or products. Regenerative medicine advanced therapies do not include those human cells, tissues, and cellular and tissue-based products regulated solely under section 361 of the Public Health Service Act and 21 CFR Part 1271. The new program is intended to facilitate efficient development and expedite review of regenerative medicine advanced therapies, which are intended to treat, modify, reverse, or cure a serious or life-threatening disease or condition. A drug sponsor may request that FDA designate a drug as a regenerative medicine advanced therapy concurrently with or at any time after submission of an IND. FDA has 60 calendar days to determine whether the drug meets the criteria, including whether there is preliminary clinical evidence indicating that the drug has the potential to address unmet medical needs for a serious or life-threatening disease or condition. A new drug application or BLA for a regenerative medicine advanced therapy may be eligible for priority review or accelerated approval through (1) surrogate or intermediate endpoints reasonably likely to predict long-term clinical benefit or (2) reliance upon data obtained from a meaningful number of sites. Benefits of such designation also include early interactions with FDA to discuss any potential surrogate or intermediate endpoint to be used to support accelerated approval. A regenerative medicine advanced therapy that is granted accelerated approval and is subject to postapproval requirements may fulfill such requirements through the submission of clinical evidence, clinical studies, patient registries, or other sources of real world evidence, such as electronic health records; the collection of larger confirmatory data sets; or post approval monitoring of all patients treated with such therapy prior to its approval.

Pediatric Trials

Under the Pediatric Research Equity Act, or PREA, a BLA or supplement to a BLA must contain data to assess the safety and efficacy 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 FDCA requires that a sponsor who is planning to submit a marketing application for a drug or biological product that includes a new active ingredient, new indication, new dosage form, new dosing regimen or new route of administration submit an initial Pediatric Study Plan, or PSP, within sixty days of an end-of-Phase 2 meeting or as may be agreed between the sponsor and FDA. The initial PSP must include an outline of the pediatric study or studies that the sponsor plans to conduct, including study objectives and design, age groups, relevant endpoints and statistical approach, or a justification for not including such detailed information, and any request for a deferral of pediatric assessments or a full or partial waiver of the requirement to provide data from pediatric studies along with supporting information. The FDA and the sponsor must reach agreement on the PSP. A sponsor can submit amendments to an agreed-upon initial PSP at any time if changes to the pediatric plan need to be considered based on data collected from nonclinical studies, early phase clinical trials, and/or other clinical development programs. The FDA may, on its own initiative or at the request of the applicant, grant deferrals for submission of data or full or partial waivers.

Post-Marketing Requirements

Following approval of a new product, a manufacturer and the approved product are subject to continuing regulation by the FDA, including, among other things, monitoring and recordkeeping activities, reporting to the applicable regulatory authorities of adverse experiences with the product, providing the regulatory authorities with updated safety and efficacy information, product sampling and distribution requirements, and complying with promotion and advertising requirements, which include, among others, standards for direct-to-consumer advertising, restrictions on promoting products for uses or in patient populations that are not described in the product's approved labeling (known as "off-label use"), limitations on industry-sponsored scientific and educational activities, and requirements for promotional activities involving the internet. Although physicians may prescribe legally available drugs and biologics for off-label uses, manufacturers may not market or promote such off-label uses.

Modifications or enhancements to the product or its labeling or changes of the site of manufacture are often subject to the approval of the FDA and other regulators, which may or may not be received or may result in a lengthy review process. Prescription drug promotional materials must be submitted to the FDA in conjunction with their first use.

In the United States, once a product is approved, its manufacture is subject to comprehensive and continuing regulation by the FDA. The FDA regulations require that products be manufactured in specific approved facilities and in accordance with cGMPs. We rely, and expect to continue to rely, on third parties for the production of clinical and commercial quantities of our products in accordance with cGMP regulations. cGMP regulations require,

among other things, quality control and quality assurance as well as the corresponding maintenance of records and documentation and the obligation to investigate and correct any deviations from cGMP. Manufacturers and other entities involved in the manufacture and distribution of approved 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 cGMP and other laws. Accordingly, manufacturers must continue to expend time, money, and effort in the area of production and quality control to maintain cGMP compliance. These regulations also impose certain organizational, procedural and documentation requirements with respect to manufacturing and quality assurance activities. BLA holders using contract manufacturers, laboratories or packagers are responsible for the selection and monitoring of qualified firms, and, in certain circumstances, qualified suppliers to these firms. These firms and, where applicable, their suppliers are subject to inspections by the FDA at any time, and the discovery of violative conditions, including failure to conform to cGMP, could result in enforcement actions that interrupt the operation of any such facilities or the ability to distribute products manufactured, processed or tested by them. Discovery of problems with a product after approval may result in restrictions on a product, manufacturer, or holder of an approved BLA, including, among other things, recall or withdrawal of the product from the market.

The FDA also may require post-approval testing, sometimes referred to as Phase 4 testing, REMS and post-marketing surveillance to monitor the effects of an approved product or place conditions on an approval that could restrict the distribution or use of the product. Discovery of previously unknown problems with a product or the failure to comply with applicable FDA requirements can have negative consequences, including adverse publicity, judicial or administrative enforcement, untitled or warning letters from the FDA, mandated corrective advertising or communications with doctors, and civil or criminal penalties, among others. Newly discovered or developed safety or effectiveness data may require changes to a product's approved labeling, including the addition of new warnings and contraindications, and also may require the implementation of other risk management measures. Also, new government requirements, including those resulting from new legislation, may be established, or the FDA's policies may change, which could delay or prevent regulatory approval of our products under development.

Other Regulatory Matters

Manufacturing, sales, promotion and other activities following product approval are also subject to regulation by numerous regulatory authorities in addition to the FDA, including, in the United States, the Centers for Medicare & Medicaid Services, or CMS, other divisions of the Department of Health and Human Services (e.g., the Office of Inspector General, or OIG, and Office for Civil Rights), the Drug Enforcement Administration, the Consumer Product Safety Commission, the Federal Trade Commission, the Occupational Safety & Health Administration, the Environmental Protection Agency and state and local governments. In the United States, sales, marketing and scientific/educational programs must also comply with federal and state fraud and abuse laws, data privacy and security laws, transparency laws, and pricing and reimbursement requirements in connection with governmental payor programs, among others. The handling of any controlled substances must comply with the U.S. Controlled Substances Act and Controlled Substances Import and Export Act. Products must meet applicable child-resistant packaging requirements under the U.S. Poison Prevention Packaging Act. Manufacturing, sales, promotion and other activities are also potentially subject to federal and state consumer protection and unfair competition laws.

The distribution of pharmaceutical products is subject to additional requirements and regulations, including extensive record-keeping, licensing, storage and security requirements intended to prevent the unauthorized sale of pharmaceutical products.

The failure to comply with regulatory requirements subjects firms to possible legal or regulatory action. Depending on the circumstances, failure to meet applicable regulatory requirements can result in criminal prosecution, fines or other penalties, injunctions, recall or seizure of products, total or partial suspension of production, denial or withdrawal of product approvals, or refusal to allow a firm to enter into supply contracts, including government contracts. In addition, even if a firm complies with FDA and other requirements, new information regarding the safety or efficacy of a product could lead the FDA to modify or withdraw product approval. Prohibitions or restrictions on sales or withdrawal of future products marketed by us could materially affect our business in an adverse way.

Changes in regulations, statutes or the interpretation of existing regulations could impact our business in the future by requiring, for example: (i) changes to our manufacturing arrangements; (ii) additions or modifications to product labeling; (iii) the recall or discontinuation of our products; or (iv) additional record-keeping requirements. If any such changes were to be imposed, they could adversely affect the operation of our business.

U.S. Patent Term Restoration and Marketing Exclusivity

Depending upon the timing, duration and specifics of the FDA approval of our drug 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 a BLA plus the time between the submission date of a BLA and the approval of that application, except that the review period is reduced by any time during which the applicant failed to exercise due diligence. Only one patent applicable to an approved drug is eligible for the extension and the application for the extension must be submitted prior to the expiration of the patent. The U.S. PTO, in consultation with the FDA, reviews and approves the application for any patent term extension or restoration. In the future, we may apply for restoration of patent term for our currently owned or licensed patents to add patent life beyond its current expiration date, depending on the expected length of the clinical trials and other factors involved in the filing of the relevant BLA.

An abbreviated approval pathway for biological products shown to be biosimilar to, or interchangeable with, an FDA-licensed reference biological product was created by the Biologics Price Competition and Innovation Act of 2009, or BPCI Act, which was part of the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act of 2010, or collectively the ACA. This amendment to the PHSA attempts to minimize duplicative testing. Biosimilarity, which requires that the biological product be highly similar to the reference product notwithstanding minor differences in clinically inactive components and that there be no clinically meaningful differences between the product and the reference product in terms of safety, purity, and potency, can be shown through analytical studies, animal studies, and a clinical trial or trials. Interchangeability requires that a biological product be biosimilar to the reference product and that the product can be expected to produce the same clinical results as the reference product in any given patient and, for products administered multiple times, that the product and the reference product 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 biological product. However, complexities associated with the larger, and often more complex, structure of biological products as compared to small molecule drugs, as well as the processes by which such products are manufactured, pose significant hurdles to implementation that are still being worked out by the FDA.

A reference biological product is granted twelve years of exclusivity from the time of first licensure of the product, and the FDA will not accept an application for a biosimilar or interchangeable product based on the reference biological product until four years after first licensure. "First licensure" typically means the initial date the particular product at issue was licensed in the United States. This does not include a supplement for the biological product or a subsequent application by the same sponsor or manufacturer of the biological product (or licensor, predecessor in interest, or other related entity) for a change that results in a new indication, route of administration, dosing schedule, dosage form, delivery system, delivery device, or strength, unless that change is a modification to the structure of the biological product and such modification changes its safety, purity, or potency. Whether a subsequent application, if approved, warrants exclusivity as the "first licensure" of a biological product is determined on a case-by-case basis with data submitted by the sponsor.

Pediatric exclusivity is another type of regulatory market exclusivity in the United States. Pediatric exclusivity, if granted, adds six months to existing exclusivity periods and patent terms. This six-month exclusivity, which attaches to the twelve-year exclusivity period for reference biologics, may be granted based on the voluntary completion of a pediatric trial in accordance with an FDA-issued "Written Request" for such a trial.

Pricing and Reimbursement

United States

Sales of our products will depend, in part, on the extent to which our products, once approved, will be covered and reimbursed by third-party payors, such as government health programs, commercial insurance and managed healthcare organizations. These third-party payors are increasingly reducing reimbursements for medical products and services. The process for determining whether a third-party payor will provide coverage for a drug product, including a biologic, typically is separate from the process for setting the price of a drug product or for establishing the reimbursement rate that a payor will pay for the drug product once coverage is approved. Third-party payors may limit coverage to specific drug products on an approved list, also known as a formulary, which might not include all of the approved drugs for a particular indication.

In order to secure coverage and reimbursement for any drug product candidate that might be approved for sale, we may need to conduct expensive pharmacoeconomic studies in order to demonstrate the medical necessity and cost-effectiveness of the drug product candidate, in addition to the costs required to obtain FDA or other comparable regulatory approvals. Whether or not we conduct such studies, our drug product candidates may not be considered medically necessary or cost-effective. A third-party payor's decision to provide coverage for a drug product does not imply that an adequate reimbursement rate will be approved. Third party reimbursement may not be sufficient to enable us to maintain price levels high enough to realize an appropriate return on our investment in product development. In the United States, the principal decisions about reimbursement for new drug products are typically made by the U.S. Centers for Medicare and Medicaid Services, or CMS, an agency within the U.S. Department of Health and Human Services, or HHS. CMS decides whether and to what extent a new drug product will be covered and reimbursed under Medicare, and private payors tend to follow CMS to a substantial degree. However, no uniform policy of coverage and reimbursement for drug products exists among third-party payors and coverage and reimbursement levels for drug products can differ significantly from payor to payor. Additionally, one third-party payor's decision to cover a particular product or service does not ensure that other payors will also provide coverage for the product or service, and the level of coverage and reimbursement can differ significantly from payor to payor. As a result, the coverage determination process will often require us to provide scientific and clinical support for the use of our products to each payor separately and can be a time-consuming process, with no assurance that coverage and adequate reimbursement will be applied consistently or obtained in the first instance.

The containment of healthcare costs has become a priority of federal and state governments, and the prices of drugs, including biologics, have been a focus in this effort. The U.S. government, state legislatures and foreign governments have shown significant interest in implementing cost-containment programs, including price controls, restrictions on reimbursement and requirements for substitution of generic products. In many countries, the prices of drug products are subject to varying price control mechanisms as part of national health systems. In general, the prices of drug products under such systems are substantially lower than in the United States. Other countries allow companies to fix their own prices for drug products, but monitor and control company profits. Accordingly, in markets outside the United States, the reimbursement for drug products may be reduced compared with the United States. Adoption of price controls and cost-containment measures, and adoption of more restrictive policies in jurisdictions with existing controls and measures, could further limit our net revenue and results. Decreases in third-party reimbursement for our drug product candidate or a decision by a third-party payor to not cover our drug product candidate could reduce physician usage of the drug product candidate and have a material adverse effect on our sales, results of operations and financial condition.

Outside of the United States, the pricing of pharmaceutical products is subject to governmental control in many countries. For example, in the European Union, pricing and reimbursement schemes vary widely from country to country. Some countries provide that products may be marketed only after a reimbursement price has been approved. Some countries may require the completion of additional studies that compare the cost effectiveness of a particular therapy to currently available therapies or so-called health technology assessments, in order to obtain reimbursement or pricing approval. Other countries may allow companies to fix their own prices for products, but monitor and control product volumes and issue guidance to physicians to limit prescriptions. Efforts to control prices and utilization of pharmaceutical products will likely continue as countries attempt to manage healthcare expenditures.

Other Healthcare Laws and Compliance Requirements

Healthcare providers, physicians, and third-party payors will play a primary role in the recommendation and prescription of any products for which we obtain marketing approval. Our business operations in the United States and our current and future arrangements with clinical investigators, healthcare providers, consultants, third-party payors and patients may expose us to broadly applicable federal and state fraud and abuse and other healthcare laws and regulations that may constrain the business or financial arrangements and relationships through which we market, sell and distribute any drugs for which we obtain marketing approval. In the United States, these laws include: the federal Anti-Kickback Statute, the False Claims Act, and HIPAA.

The Anti-Kickback Statute makes it illegal for any person, including a prescription drug manufacturer (or a party acting on its behalf), to knowingly and willfully solicit, receive, offer or pay any remuneration, directly or indirectly, in cash or in kind, that is intended to induce or reward referrals, including the purchase, recommendation, order or prescription of a particular drug, for which payment may be made under a federal healthcare program, such as Medicare or Medicaid. Violations of this law are punishable by imprisonment, criminal fines, administrative civil money penalties and exclusion from participation in federal healthcare programs. In addition, a person or entity does not need to have actual knowledge of the statute or specific intent to violate it. Moreover, the ACA 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 civil False Claims Act. On December 2, 2020, the Office of Inspector General, or OIG, published further modifications to the federal Anti-Kickback Statute. Under the final rules, OIG added safe harbor protections under the Anti-Kickback Statute for certain coordinated care and value-based arrangements among clinicians, providers, and others. This rule (with exceptions) became effective January 19, 2021. Implementation of this change and new safe harbors for point-of-sale reductions in price for prescription pharmaceutical products and pharmacy benefit manager service fees are currently under review by the Biden administration and may be amended or repealed. We continue to evaluate what effect, if any, the rule will have on our business.

Although we would not submit claims directly to payors, drug manufacturers can be held liable under the federal civil False Claims Act, which imposes civil penalties, including through civil whistleblower or qui tam actions, against individuals or entities (including manufacturers) for, among other things, knowingly presenting, or causing to be presented to federal programs (including Medicare and Medicaid) claims for items or services, including drugs, that are false or fraudulent, claims for items or services not provided as claimed, or claims for medically unnecessary items or services. Penalties for a False Claims Act violation include three times the actual damages sustained by the government, plus mandatory civil penalties for each separate false claim, the potential for exclusion from participation in federal healthcare programs and, although the federal False Claims Act is a civil statute, conduct that results in a False Claims Act violation may also implicate various federal criminal statutes. The government may deem manufacturers to have "caused" the submission of false or fraudulent claims by, for example, providing inaccurate billing or coding information to customers or promoting a product off-label. Claims which include items or services resulting from a violation of the federal Anti-Kickback Statute are false or fraudulent claims for purposes of the False Claims Act. Our future marketing and activities relating to the reporting of wholesaler or estimated retail prices for our products, if approved, the reporting of prices used to calculate Medicaid rebate information and other information affecting federal, state and third-party reimbursement for our products, and the sale and marketing of our product candidates, are subject to scrutiny under this law.

The civil monetary penalties statute imposes penalties against any person or entity that, among other things, is determined to have presented or caused to be presented a claim to a federal health 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, we may be subject to data privacy and security regulations by both the federal government and states in which we conduct our business. For example, HIPAA created new federal criminal statutes that prohibit among other things, knowingly and willfully executing, or attempting to execute, a scheme to defraud or to obtain, by means of false or fraudulent pretenses, representations or promises, any money or property owned by, or under the control or custody of, any healthcare benefit program, including private third party payors, knowingly and willfully embezzling or stealing from a healthcare benefit program, willfully obstructing a criminal investigation of a healthcare offense, and knowingly and willfully falsifying, concealing or covering up by trick, scheme or device, 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. Like the federal Anti-Kickback Statute a person or entity does not need to have actual knowledge of the statute or specific intent to violate it in order to have committed a violation.

HIPAA, as amended by HITECH, and their implementing regulations, mandates, among other things, the adoption of uniform standards for the electronic exchange of information in common healthcare transactions, as well as standards relating to the privacy and security of individually identifiable health information, which require the adoption of administrative, physical and technical safeguards to protect such information. Among other things, HITECH makes HIPAA's security standards directly applicable to business associates, defined as independent contractors or agents of covered entities, which include certain health care providers, health plans, and healthcare clearinghouses, that create, receive or obtain 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 and business associates, 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. In addition, certain state laws govern the privacy and security of health information in certain circumstances, some of which are more stringent than HIPAA and many of which differ from each other in significant ways and may not have the same effect, thus complicating compliance efforts. Failure to comply with these laws, where applicable, can result in the imposition of significant civil and criminal penalties.

Further, the federal Physician Payments Sunshine Act, or the Sunshine Act, within the ACA, and its implementing regulations, require that certain manufacturers of drugs, devices, biological and medical supplies for which payment is available under Medicare, Medicaid or the Children's Health Insurance Program (with certain exceptions) report annually to CMS information related to certain payments or other transfers of value made or distributed to physicians (defined to include doctors, dentists, optometrists, podiatrists and chiropractors) and teaching hospitals, or to entities or individuals at the request of, or designated on behalf of, physicians, certain other healthcare professionals, and teaching hospitals and to report annually certain ownership and investment interests held by physicians, certain other healthcare professionals, and their immediate family members. Effective January 1, 2022, these reporting obligations will extend to include transfers of value made to certain non-physician providers such as physician assistants and nurse practitioners. In addition, many states also govern the reporting of payments or other transfers of value, many of which differ from each other in significant ways, are often not pre-empted, and may have a more prohibitive effect than the Sunshine Act, thus further complicating compliance efforts.

Similar federal, state and foreign fraud and abuse laws and regulations, such as state anti-kickback and false claims laws, may apply to sales or marketing arrangements and claims involving healthcare items or services. Such laws are generally broad and are enforced by various state agencies and private actions. Also, many states have similar fraud and abuse statutes or regulations that may be broader in scope and may apply regardless of payor, in addition to items and services reimbursed under Medicaid and other state programs. Some state laws require pharmaceutical companies to comply with the pharmaceutical industry's voluntary compliance guidelines and the relevant federal government compliance guidance, and require drug manufacturers to report information related to payments and other transfers of value to physicians and other healthcare providers or marketing expenditures.

In order to distribute products commercially, we must comply with state laws that require the registration of manufacturers and wholesale distributors of drug and biological products in a state, including, in certain states, manufacturers and distributors who ship products into the state even if such manufacturers or distributors have no place of business within the state. Some states also impose requirements on manufacturers and distributors to establish the pedigree of product in the chain of distribution, including some states that require manufacturers and others to adopt new technology capable of tracking and tracing product as it moves through the distribution chain. Several states have enacted legislation requiring pharmaceutical and biotechnology companies to 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 and biotechnology companies for use in sales and marketing, and to prohibit certain other sales and marketing practices. All of our activities are potentially subject to federal and state consumer protection and unfair competition laws.

The scope and enforcement of each of these laws is uncertain and subject to rapid change in the current environment of healthcare reform, especially in light of the lack of applicable precedent and regulations. Federal and state enforcement bodies have recently increased their scrutiny of interactions between healthcare companies and healthcare providers, which has led to a number of investigations, prosecutions, convictions and settlements in the healthcare industry. It is possible that governmental authorities will conclude that our business practices may not comply with current or future statutes, regulations or case law involving applicable fraud and abuse or other healthcare laws and regulations. If our operations are found to be in violation of any of these laws or any other governmental regulations that may apply to us, we may be subject to significant civil, criminal and administrative penalties, damages, fines, disgorgement, contractual damages, reputational harm, diminished profits and future earnings, individual imprisonment, exclusion of drugs from government funded healthcare programs, such as Medicare and Medicaid, and the curtailment or restructuring of our operations, any of which could adversely affect our ability to operate our business and our financial results. If any of the physicians or other healthcare providers or entities with whom we expect to do business is found to be not in compliance with applicable laws, they may be subject to criminal, civil or administrative sanctions, including exclusions from government funded healthcare programs. Ensuring business arrangements comply with applicable healthcare laws, as well as responding to possible investigations by government authorities, can be time- and resource- consuming and can divert a company's attention from the business.

Current and Future Legislation

In the United States and some foreign jurisdictions, there have been, and likely will continue to be, a number of legislative and regulatory changes and proposed changes regarding the healthcare system directed at broadening the availability of healthcare, improving the quality of healthcare, and containing or lowering the cost of healthcare.

For example, in March 2010, the ACA was enacted in the United States. The ACA includes measures that have significantly changed, and are expected to continue to significantly change, the way healthcare is financed by both governmental and private insurers. Among the provisions of the ACA of greatest importance to the pharmaceutical industry are that the ACA:

1. made several changes to the Medicaid Drug Rebate Program, including increasing pharmaceutical manufacturers' rebate liability by raising the minimum basic Medicaid rebate on average manufacturer price, or AMP, on most branded prescription drugs and adding a new rebate calculation for "line extensions" (*i.e.*, new formulations, such as extended release formulations) of solid oral dosage forms of branded products, as well as potentially impacting their rebate liability by modifying the statutory definition of AMP;
2. imposed a requirement on manufacturers of branded drugs to provide a 50% point-of-sale discount (increased to 70% pursuant to the Bipartisan Budget Act of 2018, effective as of January 1, 2019) off the negotiated price of branded drugs dispensed to Medicare Part D beneficiaries in the coverage gap (*i.e.*, "donut hole") as a condition for a manufacturer's outpatient drugs being covered under Medicare Part D;
3. extended a manufacturer's Medicaid rebate liability to covered drugs dispensed to individuals who are enrolled in Medicaid managed care organizations;
4. expanded the entities eligible for discounts under the 340B Drug Discount Program;
5. established a new methodology by which rebates owed by manufacturers under the Medicaid Drug Rebate Program are calculated for drugs that are inhaled, infused, instilled, implanted, or injected;
6. imposed an annual, nondeductible fee on any entity that manufactures or imports certain branded prescription drugs, apportioned among these entities according to their market share in certain government healthcare programs, and
7. established a new Patient-Centered Outcomes Research Institute to oversee, identify priorities in, and conduct comparative clinical effectiveness research, along with funding for such research. The research conducted by the Patient-Centered Outcomes Research Institute may affect the market for certain pharmaceutical products. The ACA established the Center for Medicare and Medicaid Innovation within CMS to test innovative payment and service delivery models to lower Medicare and Medicaid spending,

potentially including prescription drug spending. Funding has been allocated to support the mission of the Center for Medicare and Medicaid Innovation through 2019.

Since its enactment, there have been numerous judicial, administrative, executive, and legislative challenges to certain aspects of the ACA. Various portions of the ACA are currently undergoing constitutional challenges in the Fifth Circuit Court and the United States Supreme Court. The former Trump Administration issued various Executive Orders eliminating cost sharing subsidies and various provisions that would impose a fiscal burden on states or a cost, fee, tax, penalty or regulatory burden on individuals, healthcare providers, health insurers, or manufacturers of pharmaceuticals or medical devices, and Congress has introduced several pieces of legislation aimed at significantly revising or repealing the ACA. It is unclear whether the ACA will be further amended, and we cannot predict what affect further changes to the ACA would have on our business, especially under the new Biden administration.

Other legislative changes have been proposed and adopted in the United States since the ACA was enacted. In August 2011, the Budget Control Act of 2011, among other things, created measures for spending reductions by Congress. A Joint Select Committee on Deficit Reduction, tasked with recommending a targeted deficit reduction of at least \$1.2 trillion for the years 2013 through 2021, was unable to reach required goals, thereby triggering the legislation's automatic reduction to several government programs. This includes aggregate reductions of Medicare payments to providers up to 2% per fiscal year, which went into effect in April 2013, following passage of the Bipartisan Budget Act of 2013 and subsequent legislation, and will remain in effect through 2030 unless additional congressional action is taken. However, pursuant to the Coronavirus Aid, Relief and Economic Security Act, or CARES Act, the 2% Medicare sequester reductions have been suspended from May 1, 2020 through March 31, 2021 due to the COVID-19 pandemic. Proposed legislation, if passed, would extend this suspension until the end of the pandemic. Further, in January 2013, President Obama signed into law the American Taxpayer Relief Act of 2012, which, among other things, further reduced Medicare payments to several providers, including hospitals, imaging centers and cancer treatment centers, and increased the statute of limitations period for the government to recover overpayments to providers from three to five years. Any reduction in reimbursement from Medicare or other government programs may result in a similar reduction in payments from private payors, which may adversely affect our future profitability. Additionally, there has been increasing legislative and enforcement interest in the United States with respect to specialty drug pricing practices.

On May 30, 2018, the Trickett Wendler, Frank Mongiello, Jordan McLinn, and Matthew Bellina Right to Try Act of 2017, or the Right to Try Act, was signed into law. The law, among other things, provides a federal framework for certain patients to request access to certain investigational new drug products that have completed a Phase I clinical trial and that are undergoing investigation for FDA approval. There is no obligation for a pharmaceutical manufacturer to make its drug products available to eligible patients as a result of the Right to Try Act.

In addition, there has been increasing legislative and enforcement interest in the United States with respect to specialty drug pricing practices. Specifically, there have been several recent U.S. Congressional inquiries and proposed and enacted federal and state legislation designed to, among other things, bring more transparency to drug pricing, review the relationship between pricing and manufacturer patient assistance programs, and reform government program reimbursement methodologies for drugs. For example, the former Trump administration's budget proposal for fiscal year 2021 included a \$135 billion allowance to support legislative proposals seeking to reduce drug prices, increase competition, lower out-of-pocket drug costs for patients, and increase patient access to lower-cost generic and biosimilar drugs. On March 10, 2020, the former Trump administration sent "principles" for drug pricing to Congress, calling for legislation that would, among other things, cap Medicare Part D beneficiary out-of-pocket pharmacy expenses, provide an option to cap Medicare Part D beneficiary monthly out-of-pocket expenses, and place limits on pharmaceutical price increases. Moreover, in May 2018, the former Trump administration also previously released its "Blueprint to Lower Drug Prices and Reduce Out-of-Pocket Costs," or the Blueprint. The Blueprint contains several potential regulatory actions and legislative recommendations aimed at lowering prescription drug prices, including measures to promote innovation and competition for biologics, changes to Medicare Part D to give plan sponsors more leverage when negotiating prices with manufacturers, and updating the Medicare drug-pricing dashboard to make price increases and generic competition more transparent. In addition, HHS released a Request for Information, or RFI, soliciting public input on ways to lower drug pricing. HHS has already started the process of soliciting feedback on some of these measures and, at the same, is immediately implementing others under its existing authority. For example, in May 2019, CMS issued a final rule to allow Medicare Advantage Plans the option of using step therapy, a type of prior authorization, for Part B drugs beginning January 1, 2020. This final rule codified CMS's policy change that was effective January 1, 2019. It is unclear

whether the Biden administration will challenge, reverse, revoke or otherwise modify these executive and administrative actions after January 20, 2021.

In addition, there have been several changes to the 340B drug pricing program, which imposes ceilings on prices that drug manufacturers can charge for medications sold to certain health care facilities. It is unclear how these developments could affect covered hospitals who might purchase our future products and affect the rates we may charge such facilities for our approved products in the future, if any.

On July 24, 2020 and September 13, 2020, President Trump announced several executive orders related to prescription drug pricing that seek to implement several of the administration's proposals. In response, the FDA released a final rule on September 24, 2020, which went into effect on November 30, 2020, providing guidance for states to build and submit importation plans for drugs from Canada. Further, on November 20, 2020 CMS issued an Interim Final Rule implementing the Most Favored Nation, or MFN, Model under which Medicare Part B reimbursement rates will be calculated for certain drugs and biologicals based on the lowest price drug manufacturers receive in Organization for Economic Cooperation and Development countries with a similar gross domestic product per capita. However, in response to a lawsuit filed by several industry groups, on December 28, the U.S. District Court for the Northern District of California issued a nationwide preliminary injunction enjoining government defendants from implementing the MFN Rule pending completion of notice-and-comment procedures under the Administrative Procedure Act. On January 13, 2021, in a separate lawsuit brought by industry groups in the U.S. District of Maryland, the government defendants entered a joint motion to stay litigation on the condition that the government would not appeal the preliminary injunction granted in the U.S. District Court for the Northern District of California and that performance for any final regulation stemming from the MFN Interim Final Rule shall not commence earlier than 60 days after publication of that regulation in the Federal Register. Further, authorities in Canada have passed rules designed to safeguard the Canadian drug supply from shortages. If implemented, importation of drugs from Canada and the MFN Model may materially and adversely affect the price we receive for any of our product candidates.

Additionally, on December 2, 2020, HHS finalized a regulation removing safe harbor protection for price reductions from pharmaceutical manufacturers to plan sponsors under Part D, either directly or through pharmacy benefit managers, unless the price reduction is required by law. The rule also creates a new safe harbor for price reductions reflected at the point-of-sale, as well as a safe harbor for certain fixed fee arrangements between pharmacy benefit managers and manufacturers. Pursuant to an order entered by the U.S. District Court for the District of Columbia, the portion of the rule eliminating safe harbor protection for certain rebates related to the sale or purchase of a pharmaceutical product from a manufacturer to a plan sponsor under Medicare Part D has been delayed to January 1, 2023. Further, implementation of this change and new safe harbors for point-of-sale reductions in price for prescription pharmaceutical products and pharmacy benefit manager service fees are currently under review by the Biden administration and may be amended or repealed. While many of the proposed measures will require authorization through additional legislation to become effective, and the Biden Administration may reverse or otherwise change these measures, Congress has indicated that it will continue to seek new legislative, administrative and/or additional measures to control drug costs.

We cannot predict what healthcare reform initiatives may be adopted in the future. Further federal, state and foreign legislative and regulatory developments are likely, and we expect ongoing initiatives to increase pressure on drug pricing. Such reforms could have an adverse effect on anticipated revenues from product candidates and may affect our overall financial condition and ability to develop product candidates.

The Foreign Corrupt Practices Act

The FCPA prohibits any U.S. individual or business from paying, offering, or authorizing payment or offering of anything of value, directly or indirectly, to any foreign official, political party or candidate for the purpose of influencing any act or decision of the foreign entity in order to assist the individual or business in obtaining or retaining business. The FCPA also obligates companies whose securities are listed in the United States to comply with accounting provisions requiring the company to maintain books and records that accurately and fairly reflect all transactions of the corporation, including international subsidiaries, and to devise and maintain an adequate system of internal accounting controls for international operations.

Additional Regulation

In addition to the foregoing, state and federal laws regarding environmental protection and hazardous substances, including the Occupational Safety and Health Act, the Resource Conservancy and Recovery Act and the Toxic Substances Control Act, 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.

Europe / Rest of World Government Regulation

In addition to regulations in the United States, we may be subject to a variety of regulations in other jurisdictions that we may in the future select governing, among other things, clinical trials and any commercial sales and distribution of our products. Whether or not we obtain FDA approval of a product, we would need to obtain the requisite approvals from regulatory authorities in foreign countries prior to the commencement of clinical trials or marketing of the product in those countries. Certain countries outside of the United States have a similar process that requires the submission of a clinical trial application much like the IND prior to the commencement of human clinical trials. In the EU, for example, a clinical trial application must be submitted to each country's national health authority and an independent ethics committee, much like the FDA and IRB, respectively. Once the clinical trial application is approved in accordance with a country's requirements, clinical trial development may proceed. Because biologically sourced raw materials are subject to unique contamination risks, their use may be restricted in some countries.

The requirements and process governing the conduct of clinical trials, product licensing, pricing and reimbursement vary from country to country. In all cases, the clinical trials must be 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 an MAA. The application used to file the BLA in the United States is similar to that required in the EU, with the exception of, among other things, country-specific document requirements.

For other countries outside of the EU, such as countries in Eastern Europe, Latin America or Asia, the requirements governing the conduct of clinical trials, product licensing, pricing and reimbursement vary from country to country. In all cases, again, the clinical trials must be 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 or our potential collaborators 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.

European Union General Data Protection Regulation

In addition to EU regulations related to the approval and commercialization of our products, we may be subject to the EU's General Data Protection Regulation, or GDPR. The GDPR imposes stringent requirements for controllers and processors of personal data of persons in the EU, including, for example, more robust disclosures to individuals and a strengthened individual data rights regime, shortened timelines for data breach notifications, limitations on retention of information, increased requirements pertaining to special categories of data, such as health data, and additional obligations when we contract with third-party processors in connection with the processing of the personal data. The GDPR also imposes strict rules on the transfer of personal data out of the European Union to the United States and other third countries. In addition, the GDPR provides that EU member states may make their own further laws and regulations limiting the processing of personal data, including genetic, biometric or health data.

The GDPR applies extraterritorially, and we may be subject to the GDPR because of our data processing activities that involve the personal data of individuals located in the European Union, such as in connection with our EU clinical trials. Failure to comply with the requirements of the GDPR and the applicable national data protection laws of the EU member states may result in fines of up to €20,000,000 or up to 4% of the total worldwide annual turnover of the preceding financial year, whichever is higher, and other administrative penalties. GDPR regulations

may impose additional responsibility and liability in relation to the personal data that we process and we may be required to put in place additional mechanisms to ensure compliance with the new data protection rules.

Employees

As of December 31, 2020, we had 34 employees, 33 of whom were full-time. Of those, 27 were engaged in research and development activities. All company employees are located in the United States. We do not have any employees that are represented by a labor union or covered under a collective bargaining agreement. We consider our relationship with our employees to be good.

Corporate History and Trademarks

We were incorporated under the laws of the State of Delaware in April 2017 under the name Tycho Therapeutics, Inc. In August 2018, our corporate name was changed to Cabaletta Bio, Inc. Our principal executive offices are located at 2929 Arch Street, Suite 600, Philadelphia, PA 19104 and our telephone number is (267) 759-3100. Our website address is www.cabalettabio.com. We do not incorporate the information on or accessible through our website into this Annual Report on Form 10-K, and you should not consider any information on, or that can be accessed through, our website to be part of this Annual Report on Form 10-K. We have included our website address in this Annual Report on Form 10-K solely as an inactive textual reference.

We view our operations and measure our business as one reportable segment. All of the Company's tangible assets are held in the United States. Refer to Note 2, Summary of Significant Accounting Policies, to our financial statements appearing elsewhere in this Annual Report on Form 10-K for additional information.

We own or have rights to various trademarks, service marks and trade names that we use in connection with the operation of our business. This Annual Report on Form 10-K may also contain trademarks, service marks and trade names of third parties, which are the property of their respective owners. Our use or display of third parties' trademarks, service marks, trade names or products in this Annual Report on Form 10-K is not intended to, and does not imply a relationship with, or endorsement or sponsorship by us. Solely for convenience, the trademarks, service marks and trade names referred to in this Annual Report on Form 10-K may appear without the ®, ™ or SM symbols, but the omission of such references is not intended to indicate, in any way, that we will not assert, to the fullest extent under applicable law, our rights or the right of the applicable owner of these trademarks, service marks and trade names.

Available Information

Our Annual Reports on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K and any amendments to these reports filed or furnished pursuant to Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended, are available free of charge on our website located at www.cabalettabio.com as soon as reasonably practicable after they are filed with or furnished to the SEC. These reports are also available at the SEC's Internet website at www.sec.gov.

A copy of our Corporate Governance Guidelines, Code of Conduct and Business Ethics and the charters of the Audit Committee, Compensation Committee and Nominating and Corporate Governance Committee are posted on our website, www.cabalettabio.com, under the heading "Investors & Media."

Item 1A. Risk Factors.

Our business involves material and other risks, some of which are summarized and described below. You should carefully consider the risks and uncertainties described below, together with all of the other information contained in this Annual Report on Form 10-K, including "Management's Discussion and Analysis of Financial Condition and Results of Operations" and the condensed financial statements and the related notes. If any of the following risks actually occur, it could harm our business, prospects, operating results and financial condition and future prospects. In such event, the market price of our common stock could decline and you could lose all or part of your investment. Additional risks and uncertainties not presently known to us or that we currently deem immaterial may also impair our business operations. This Annual 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 Annual Report.

Risks Related to Our Business, Technology and Industry

Risks Related to Clinical Development

We are early in our development efforts. If we are unable to advance our product candidates through clinical development, obtain regulatory approval and ultimately commercialize our product candidates, or experience significant delays in doing so, our business will be materially harmed.

We are early in our development efforts and we have only initiated one clinical trial to date: our DesCAARTes™ trial in June 2020. Our ability to generate product revenues, which we do not expect will occur for many years, if ever, will depend heavily on the successful development and eventual commercialization of one or more of our product candidates. Even if we are able to develop and commercialize a marketable product, we may face challenges generating revenue from product sales. The success of our product candidates will depend on several factors, including the following:

- successful completion of preclinical studies resulting in data that is supportive of advancing to an IND submission;
- successful submission and acceptance of INDs or comparable applications;
- successful initiation of clinical trials;
- demonstration of adequate safety to progress to a therapeutic dose level;
- successful patient enrollment in and completion of clinical trials;
- receipt and related terms of regulatory and marketing approvals and licensures from applicable regulatory authorities;
- establishing commercial manufacturing capabilities or making arrangements with third-party manufacturers for clinical supply and commercial manufacturing of our product candidates;
- making arrangements with various medical divisions across hospitals for administration of our product candidates, including with cancer treatment centers to conduct leukapheresis and with the relevant hospital divisions to perform infusion;
- obtaining and maintaining patent and trade secret protection and regulatory exclusivity for our product candidates;
- establishing sales, marketing and distribution and patient administration capabilities and launching commercial sales of our products, if and when licensed, whether alone or in collaboration with others;
- acceptance of our products, if and when licensed, by patients, the medical community and third-party payors;
- effectively competing with other therapies targeting the same indications as our product candidates;
- obtaining and maintaining third-party coverage and adequate reimbursement; and
- maintaining a continued acceptable safety profile of our products following licensure.

If we do not achieve one or more of these factors in a timely manner or at all, we could experience significant delays or be unable to successfully commercialize our product candidates, which would materially harm our business. If we do not receive regulatory approvals for our product candidates, we may not be able to continue our operations.

Cellular therapies, including our engineered CAAR T product candidates, represent a novel approach to the treatment of B cell-mediated autoimmune diseases, which creates significant challenges for us. Negative perception or increased regulatory scrutiny of any product candidates that we develop could adversely affect our ability to conduct our business or obtain regulatory approvals for such product candidates.

Cellular therapies are a novel approach and negative perception or increased regulatory scrutiny of any product candidates that we develop could adversely affect our ability to conduct our business or obtain regulatory approvals for such product candidates. Cellular therapies in general, and CAAR T cell therapies in particular, remain novel therapies, with no cellular immunotherapies licensed to date in the United States or the European Union to treat autoimmune diseases or alloimmune responses. CAAR T cell therapies may not gain the acceptance of the public or the medical community. For example, CAR Ts and other cellular therapies have in some cases caused severe side effects, including death, and their broader use may therefore be limited. Even if CAR Ts and other cellular therapies are accepted by the public and medical community in the short term, long-term adverse events observed in these therapies may increase negative perception and regulatory scrutiny. Although our CAAR Ts are different from CAR Ts and other cellular therapies, they may be viewed in the same vein, limiting their market acceptance. Public perception may be influenced by claims that gene therapy, including the insertion of a transgene, is unsafe, and products incorporating gene therapy may not gain the acceptance of the public or the medical community. The patient populations targeted by our product candidates are also typically not at risk of near-term death, even if they may suffer life-threatening symptoms, so patients will need to deem the benefits of cell therapy to be worth the risk of unknown potential adverse side effects. Our success will depend upon physicians who specialize in the treatment of B cell-mediated autoimmune diseases targeted by our product candidates prescribing treatments that involve the use of our product candidates in lieu of, or in addition to, existing treatments with which they are more familiar and for which greater clinical data may be available. Adverse events in clinical trials of our product candidates or in clinical trials of others developing similar products and the resulting publicity, as well as any other adverse events in the field of cellular therapies, could result in a decrease in demand for any product that we may develop.

We are developing a pipeline of CAAR T product candidates that are intended for use in treating individuals with B cell-mediated autoimmune disease. Advancing these novel product candidates creates significant challenges for us, including:

- manufacturing our product candidates to our specifications and in a timely manner to support our clinical trials, and, if licensed, commercialization;
- sourcing clinical and, if licensed, commercial supplies for the materials used to manufacture our product candidates;
- understanding and addressing variability in the quality and quantity of a subject's T cells, which could ultimately affect our ability to manufacture clinical supply and, if licensed, commercial supply of our product candidates in a reliable and consistent manner;
- educating medical personnel regarding the potential side effect profile of our product candidates, if licensed, such as the potential adverse side effects related to pemphigus flare from infusion of activated T cells or medication taper, cytokine release syndrome, or CRS, or other unexpected adverse effects of therapy with our product candidates;
- facilitating patient access to the limited number of facilities able to administer our product candidates, if licensed;
- using medicines to manage adverse side effects of our product candidates that may not adequately control the side effects and/or may have a detrimental impact on the efficacy of the treatment;
- potentially utilizing preconditioning agents in patients to enhance engraftment in advance of administering our product candidates, which may increase the risk of adverse side effects;

- obtaining and maintaining regulatory approval for our product candidates, as the FDA and other regulatory authorities have limited or no experience with development of engineered T cell therapies for the treatment of B cell-mediated autoimmune diseases;
- establishing sales and marketing capabilities upon obtaining any regulatory approval to gain market acceptance of a novel therapy; and
- managing costs of inputs and other supplies while scaling production.

In addition, preclinical murine and other animal models may not exist or be adequate for some or all of the B cell-mediated autoimmune diseases we choose to pursue in our programs, and because we are early in the clinical development process, we are unable to predict whether there may be short-term or long-term effects from treatment with any product candidates that we develop. In developing our product candidates, we have not exhaustively explored different options in the method for manufacturing CAAR T cells. We may find our existing manufacturing process may be substantially improved with future design or process changes, necessitating further clinical testing, delaying commercial launch of our first products, and causing us to incur additional expenses. For example, while we have used a lentiviral vector in our manufacturing process, we may in the future find that another viral vector or non-viral vector-based process offers advantages. Switching from one lentiviral vector to another or switching from lentiviral to another delivery system would necessitate additional process development and clinical testing, and this may delay the development of existing product candidates.

In addition, we do not know the doses to be evaluated in pivotal trials or, if licensed, commercially. Finding a suitable dose may delay our anticipated clinical development timelines. Our expectations with regard to our scalability and costs of manufacturing may vary significantly as we develop our product candidates and understand these critical factors. We may experience delays in developing a sustainable, reproducible and scalable manufacturing process or transferring that process to commercial partners, which may prevent us from completing our clinical studies or commercializing our product candidates on a timely or profitable basis, if at all.

Moreover, our product candidates may not perform successfully in clinical trials or may be associated with adverse events that distinguish them from the chimeric antigen receptor T, or CAR T, therapies that have previously been licensed. For instance, subjects in our clinical trials will be infused with our proposed therapies, and may possess strongly activating soluble antibodies, which, are not present in oncology patients and when they interact with our infused product candidates, could result in potential adverse side effects, such as CRS. Unexpected side effects or clinical outcomes would significantly impact our business. Adverse side effects caused by even one of our product candidates could negatively affect our ability to develop future product candidates based on our CABA platform.

In addition, two of our current product candidates, DSG3/1-CAART and FVIII-CAART, and certain of our future product candidates may require introducing large transgenes into T cells, and lentiviral vectors may have too limited a genome capacity to accomplish this process. We currently use lentiviral vector transduction for transgene delivery. However, lentiviral vectors have a limited genome capacity that restricts the size of the transgene that can be delivered using this vector system. For example, designing a lentiviral vector that will have sufficient capacity to introduce DSG3 CAAR and DSG1 CAAR together into T cells may not be possible. In addition to reducing lentiviral vector titers that may substantially increase the cost of gene transfer, it may be entirely unsuccessful, thus necessitating use of alternative strategies for transfer of these larger transgenes into T cells.

Further, the clinical study requirements of the FDA and other regulatory agencies and the criteria they use to determine the safety, potency and purity of a product candidate are determined according to the type, complexity, novelty and intended use and market of the potential products. The regulatory approval process for novel product candidates such as ours is less clear, and can be more complex and consequently have higher development risk, be more expensive and take longer than for other, better known or extensively studied pharmaceutical or other product candidates. Approvals by the FDA for existing cell therapies treating B cell-mediated diseases, such as Kymriah (Novartis Pharmaceuticals Corporation) and Yescarta (Gilead Sciences, Inc.), may not be indicative of what the FDA may require for approval of our therapies. Approvals by any regulatory agency may not be indicative of what any other regulatory agency may require for approval or what such regulatory agencies may require for approval in connection with new product candidates. As we advance our product candidates, we will be required to consult with these regulatory agencies and comply with applicable requirements and guidelines. If we fail to do so, we may be

required to delay or discontinue development of such product candidates. These additional processes may result in a review and approval process that is longer than we otherwise would have expected. More restrictive statutory regimes, government regulations or negative public opinion would have an adverse effect on our business, financial condition, results of operations and prospects and may delay or impair the development and commercialization of our product candidates or demand for any products we may develop.

In addition, responses by agencies at the federal and state level to negative public perception or ethical concerns may result in new legislation or regulations that could limit our ability to develop or commercialize any product candidates, obtain or maintain regulatory approval or otherwise achieve profitability. The FDA has expressed interest in further regulating biotechnology products, such as cellular therapies. Agencies at both the federal and state level in the United States, as well as the U.S. Congressional committees and other government entities or governing agencies have also expressed interest in further regulating the biotechnology industry. Such action may delay or prevent commercialization of some or all of our product candidates. Adverse developments in clinical trials of cellular therapy products conducted by others may cause the FDA or other oversight bodies to change the requirements for approval of any of our product candidates. These regulatory review agencies and committees and the new requirements or guidelines they promulgate may lengthen the regulatory review process, require us to perform additional studies or trials, increase our development costs, lead to changes in regulatory positions and interpretations, delay or prevent approval and commercialization of our product candidates or lead to significant post-approval limitations or restrictions.

Patients receiving T cell-based immunotherapies, such as our product candidates, may experience serious adverse events, including neurotoxicity, CRS and killing of cells other than the intended B cells that express the autoantibodies. If our product candidates are revealed to have high and unacceptable severity and/or prevalence of side effects or unexpected characteristics, their clinical development, regulatory approval, and commercial potential will be negatively impacted, which will significantly harm our business, financial condition and prospects.

Our product candidates are CAAR T cell-based immunotherapies. There is a possibility that our product candidates could have adverse side effects, such as neurotoxicity and CRS. In other similarly designed cellular immunotherapies to treat cancer, there have been life threatening events related to severe neurotoxicity and CRS requiring intense medical intervention, such as intubation or medications to support blood pressure, and in several cases, resulted in death. Severe neurotoxicity is a condition that is currently defined clinically by cerebral edema, confusion, drowsiness, speech impairment, tremors, seizures or other central nervous system side effects, when such side effects are serious enough to lead to intensive care. CRS is a condition that is currently defined clinically by certain symptoms related to the release of cytokines, which can include fever, chills and low blood pressure, when such side effects are serious enough to lead to intensive care with mechanical ventilation or significant medications to support blood pressure.

Our product candidates may have serious and potentially fatal targeting of cells within the body due to unexpected protein interactions with the CAAR. Although we have completed multiple preclinical studies designed to screen for toxicity caused by unintended off-target recognition by the cell binding domain of the DSG3 CAAR, our product candidates may still recognize and react with one or more proteins unrelated to the intended surface immunoglobulin target protein to which it is designed to link. If unexpected binding occurs in normal tissue, our product candidates may target and kill the normal tissue in a patient, leading to serious and potentially fatal adverse events, undesirable side effects, toxicities or unexpected characteristics. Detection of any unexpected targeting may halt or delay any ongoing clinical trials for our product candidates and prevent or delay regulatory approval. While we have developed a preclinical screening process to identify cross-reactivity of our product candidates, we cannot be certain that this process will identify all potential tissue that our product candidates may target. For example, a membrane protein array with DSG3-CAART yielded one weak signal against a protein that is designed to bind to glycoproteins and which was detected in both the test and control conditions. Further analysis of this protein in confirmatory cell-based assays repeatedly demonstrated that DSG3-CAART does not recognize nor activate against this protein. However, this further analysis may prove to be inaccurate. Any unexpected targeting that impacts patient safety could materially impact our ability to advance our product candidates into clinical trials or to proceed to marketing approval and commercialization.

Results of our studies could reveal a high and unacceptable severity and prevalence of side effects or unexpected characteristics. Undesirable side effects caused by our product candidates could cause us or regulatory

authorities to interrupt, delay or halt clinical trials and could result in a more restrictive label or the delay or denial of regulatory approval by the FDA. The FDA has requested and we have agreed to provide data on the subjects dosed in Part A of our DesCAARTes™ trial prior to dosing subjects in Part B. The FDA has communicated that the dosing of patients in Part B1 is not dependent on the review of Part A data and that they will provide feedback, if any, in a timely manner. In some cases, side effects such as neurotoxicity or CRS have resulted in clinical holds of ongoing clinical trials and/or discontinuation of the development of the product candidate. Given that the autoimmune and alloimmune diseases we are seeking to treat are, in some cases, less serious than the later stage cancers being treated with other immunotherapy products, we believe the FDA and other regulatory authorities likely will apply a different benefit-risk assessment thresholds such that even if our product candidate demonstrated a similar safety profile as current CAR T therapies, the FDA may ultimately determine that the harmful side effects outweigh the benefits and require us to cease clinical trials or deny approval of our product candidates. We believe tolerance for adverse events in the patient population being pursued with CAAR T cell therapies will be lower than it is in oncology, and the risks of negative impact from these toxicities may therefore be higher for us than for CAR T programs in oncology.

Furthermore, treatment-related side effects could also affect patient recruitment or the ability of enrolled patients to complete the studies or result in potential product liability claims. In addition, these side effects may not be appropriately recognized or managed by the treating medical staff, as toxicities resulting from T cell-based immunotherapies are not normally encountered in routine medical care. Medical personnel may need additional training regarding T cell-based immunotherapy product candidates to understand their side effects. Inadequate training in recognizing or failure to effectively manage the potential side effects of T cell-based immunotherapy product candidates could result in patient deaths. Any of these occurrences may harm our business, financial condition and prospects significantly.

In addition to side effects caused by our product candidates, the preconditioning, administration process or related procedures, which we evaluate from time to time as part of our process improvement and optimization efforts, may also cause adverse side effects. For example, severe neurotoxicity has been noted to be associated with the use of certain lymphodepleting regimens. While we believe there are sufficient data from other CAR T programs to suggest that it is reasonable for us to initiate our first clinical trial of DSG3-CAART without a preconditioning regimen, we cannot be certain that a preconditioning regimen, with or without lymphodepleting agents, will not be required.

Although we plan to infuse DSG3-CAART without preconditioning initially in our DesCAARTes™ trial, we may in the future use a preconditioning regimen for our CAAR T cell product candidates, which may increase the risk of adverse side effects and impact our ability to accurately assess the efficacy of our product candidates.

In oncology patients receiving CAR T cell therapy, a lymphodepleting preconditioning regimen is typically used to condition the patient prior to CAR T cell infusion in order to improve tumor immunogenicity and to promote the expansion of the infused CAR T cells. Together, these effects have been shown to enhance the clinical activity of CAR T cells in oncology patients. These regimens often include cyclophosphamide and fludarabine and are usually administered within the week prior to infusion of CAR T cells. Serious adverse events have been observed in some patients following CAR T cell infusion, and these include infection, cytokine release syndrome and neurotoxicity. The preconditioning regimen may contribute to the occurrence and severity of these adverse events due to its role in inducing lymphopenia, or low levels of lymphocytes in the blood, and enhanced CAR T cell activity.

Lymphodepleting preconditioning may not be required in all oncology settings for CAR T cell activity. A recent clinical trial in multiple myeloma patients published in 2019 in *The Journal of Clinical Investigation* showed similar clinical activity of CAR T cell infusions in patients with or without a lymphodepleting preconditioning regimen. Furthermore, the requirement for lymphodepleting preconditioning for potentiating engineered T cell therapy outside of oncology has not been well established. Specifically, the effect on tumor immunogenicity is not relevant in settings outside oncology, and therefore the contribution of this aspect to the potential enhancing effect of preconditioning would not apply.

In addition, a lymphodepleting regimen may eliminate pathogenic B cells targeted by our CAAR T cell product candidates. As a result, any lymphodepleting regimen for preconditioning that we use may adversely affect our ability to use DSG3 autoantibody titers, a standard clinical assay, to assess the activity of DSG3-CAART. An

inability to use DSG3 autoantibody levels to demonstrate the specific activity of our CAAR T cell product candidates may require us to rely on the subjective measurement of blister formation in patients, which can be a less sensitive and accurate measurement of CAAR T cell activity. This therefore could delay efficient clinical development. As a result of these factors, including the concern that lymphodepletion may confer a potential increased safety risk to an autoimmune patient population, we believe the inclusion of such a regimen must be justified by clinical data demonstrating the need for it in the setting of autoimmune patients and is therefore difficult to justify in our first-in-human studies.

We initiated our DesCAARTes™ trial without a preconditioning regimen. If clinical data suggest that a preconditioning regimen is advisable, or if FDA requires that we employ a preconditioning regimen, we may employ such a regimen. If we ultimately use a preconditioning regimen, with or without lymphodepleting agents, prior to infusing patients with our CAAR T cell product candidates, our clinical patients may experience increased or more severe adverse effects specifically related to the preconditioning regimen, some of which may result in death. These undesirable side effects, whether associated with the preconditioning regimen alone or in combination with our CAAR T cell product candidates, could cause delays in patient enrollment in our clinical trials, could cause us or regulatory authorities to interrupt, delay or halt clinical trials and could result in a change to our clinical trial design, a more restrictive label or the delay or denial of regulatory approval by the FDA. Any of the foregoing may increase the duration and expense of the clinical development of our product candidates or limit market acceptance of such product candidates, if approved, any of which could have a material adverse effect on our business and financial condition. Even if we do not use a preconditioning regimen, patients may experience adverse effects related to our CAAR T cell product candidates, and our decision to design our clinical trials without preconditioning does not eliminate the risk of those side effects.

Our business is highly dependent on the success of our initial product candidates targeting B cell-mediated autoimmune diseases, particularly DSG3-CAART. All of our product candidates will require significant additional preclinical and clinical development before we can seek regulatory approval for and launch a product commercially.

Our business and future success depend on our ability to obtain regulatory approval of, and then successfully launch and commercialize our initial product candidates targeting B cell-mediated autoimmune diseases, including DSG3-CAART, MuSK-CAART, DSG3/1-CAART and others that may be selected from preclinical programs. Our product candidates are in the early stages of development and will require additional preclinical studies, clinical trials, regulatory review and licensure, substantial investment, access to sufficient commercial manufacturing capacity and significant marketing efforts before we can generate any revenue from product sales. There is no guarantee that we will be able to advance our product candidates through clinical development or obtain marketing approval for any of our product candidates. The process for obtaining marketing approval for any product candidate is very long and risky and there will be significant challenges for us to address in order to obtain marketing approval as planned, if at all.

Our IND was cleared in September 2019, and we initiated our DesCAARTes™ trial in June 2020. We announced dosing of the first patient in this trial in December 2020. Until dosing of this patient, DSG3-CAART had only been administered in murine models, and the preclinical results we have observed may not be predictive of the results of our clinical trial or any future clinical trials. Because DSG3-CAART is the first product candidate that we are testing in the clinic, we may experience preliminary complications surrounding trial design, protocol establishment and execution, establishing trial protocols, patient recruitment and enrollment, quality and supply of clinical doses, or safety issues. For example, while the majority of oncology CAR T clinical trials have been conducted with a lymphodepleting or other preconditioning regimen prior to infusion, we do not intend to use pre-infusion lymphodepletion or other preconditioning regimen initially in our Phase 1 trial. However, we may determine that use of a lymphodepleting or other preconditioning regimen is necessary for our product candidates to be successful, which could result in delays in clinical development and will expose patients to the associated risks.

Additionally, a failure of our clinical trial of DSG3-CAART could influence physicians' and regulators' opinions with regard to the viability of our CABA platform more broadly, particularly if treatment-related side effects are observed. The occurrence of any of these risks could significantly harm our development plans and business prospects. If treatment-related side effects are observed with the administration of DSG3-CAART, or if it is viewed as less safe, potent or pure than other therapies, our ability to develop other CAAR T cell therapies may be significantly harmed.

We have never successfully completed any clinical trials, and we may be unable to do so for any product candidates we develop.

We have not yet demonstrated our ability to successfully complete any clinical trials, including large-scale, pivotal clinical trials, obtain regulatory approvals, manufacture a commercial scale product, or arrange for a third party to do so on our behalf, or conduct sales and marketing activities necessary for successful commercialization. Although our key employees have significant experience in leading clinical development programs, we have no experience as a company in conducting clinical trials beyond our current DesCAARTes™ trial initiated in June 2020. Otherwise, we currently have ongoing IND-enabling studies for our MuSK CAAR T program, with a planned IND submission anticipated in the second half of 2021. We may not be able to file such IND or INDs for any of our other product candidates on the timelines we expect, if at all. For example, we may experience manufacturing delays with IND-enabling studies. Moreover, we cannot be sure that submission of an IND will result in the FDA allowing further clinical trials to begin, or that, once begun, issues will not arise that require us to suspend or terminate clinical trials. Commencing each of these clinical trials is subject to finalizing the trial design based on discussions with the FDA and other regulatory authorities. Any guidance we receive from the FDA or other regulatory authorities is subject to change. These regulatory authorities could change their position, including, on the acceptability of our trial designs or the clinical endpoints selected, which may require us to complete additional clinical trials or impose stricter approval conditions than we currently expect.

If we are required to conduct additional clinical trials or other testing of our product candidates beyond those that we currently contemplate, if we are unable to successfully complete clinical trials of our product candidates or other testing, if the results of these trials or tests are not positive or are only modestly positive or if there are safety concerns, we may:

- be delayed in obtaining marketing approval for our product candidates;
- not obtain marketing approval at all;
- obtain approval for indications or patient populations that are not as broad as intended or desired;
- be subject to post-marketing testing requirements; or
- have the product removed from the market after obtaining marketing approval.

We may not be able to file INDs to commence clinical trials on the timelines we expect, and even if we are able to, the FDA may not permit us to proceed.

We submitted an IND to the FDA to initiate a clinical trial of DSG3-CAART targeting mPV in August 2019, which was cleared by the FDA in September 2019. The timing of submissions on future product candidates will be dependent on further preclinical and manufacturing success. We cannot be sure that submission of an IND or IND amendment will result in the FDA allowing testing and clinical trials to begin, or that, once begun, issues will not arise that would cause us or the FDA to suspend or terminate such clinical trials. Additionally, even if such regulatory authorities agree with the design and implementation of the clinical trials set forth in an IND or clinical trial application, we cannot guarantee that such regulatory authorities will not change their requirements in the future.

Risks Related to the Current Novel Coronavirus (COVID-19) Pandemic

The COVID-19 pandemic and the future outbreak of other highly infectious or contagious diseases could seriously harm our research, development and potential future commercialization efforts, increase our costs and expenses and have a material adverse effect on our business, financial condition and results of operations.

Public health crises such as pandemics or similar outbreaks could adversely impact our business, the business operations of third parties on whom we rely and our ongoing or planned research and development activities. In December 2019, a novel strain of coronavirus surfaced in Wuhan, China and has since reached multiple other regions and countries, including Philadelphia, Pennsylvania where our primary office and laboratory space, as well as certain of our CMO partners, are located. The COVID-19 pandemic is evolving, and to date has led to the implementation of various responses, including government-imposed quarantines, travel restrictions and other public

health safety measures. The extent to which COVID-19 impacts our operations or those of our third party partners will depend on future developments, which are highly uncertain and cannot be predicted with confidence, including the duration of the pandemic, new information that may emerge concerning the severity of COVID-19, the impact of new strains of the virus, the effectiveness and availability of vaccines and the actions to contain COVID-19 or treat its impact, among others.

Additionally, timely enrollment in our ongoing and planned clinical trials is dependent upon clinical trial sites which will be adversely affected by global health matters, such as COVID-19. We plan to conduct clinical trials for our product candidates in geographies which are currently being affected by COVID-19. Some factors from the COVID-19 pandemic that have delayed and could further delay or otherwise adversely affect enrollment in the clinical trials of our product candidates, as well as our business generally, include:

- the potential diversion of healthcare resources away from the conduct of clinical trials to focus on pandemic concerns, including the attention of physicians serving as our clinical trial investigators, hospitals serving as our clinical trial sites and hospital staff supporting the conduct of our prospective clinical trials;
- limitations on travel that could interrupt key trial and business activities, such as clinical trial site initiations and monitoring, domestic and international travel by employees, contractors or patients to clinical trial sites, including any government-imposed travel restrictions or quarantines that will impact the ability or willingness of patients, employees or contractors to travel to our clinical trial sites or secure visas or entry permissions, a loss of face-to-face meetings and other interactions with potential partners, any of which could delay or adversely impact the conduct or progress of our prospective clinical trials;
- interruption in global shipping affecting the transport of clinical trial materials, such as patient samples, investigational drug product and conditioning drugs and other supplies used in our prospective clinical trials;
- interruptions in operations at our third-party manufacturers, which could result in delays or disruptions in the supply of our current product candidates and any future product candidates; and
- business disruptions caused by potential workplace, laboratory and office closures and an increased reliance on employees working from home, disruptions to or delays in ongoing laboratory experiments and operations, product manufacturing and supply, staffing shortages, travel limitations or mass transit disruptions, any of which could adversely impact our business operations or delay necessary interactions with local regulators, ethics committees and other important agencies and contractors.

These and other factors arising from the coronavirus could continue to worsen. Any of these factors, and other factors related to any such disruptions that are unforeseen, could have a material adverse effect on our business and our results of operation and financial condition. Further, uncertainty around these and related issues could lead to adverse effects on the economy of the United States and other economies, which could impact our ability to raise the necessary capital needed to develop and commercialize our product candidates.

Risks Related to the Industry

Our product candidates may cause undesirable side effects or have other properties that could halt their clinical development, prevent their regulatory approval, limit their commercial potential or result in significant negative consequences.

Undesirable or unacceptable side effects caused by our product candidates could cause us or regulatory authorities to interrupt, delay or halt clinical trials and could result in a more restrictive label or the delay or denial of regulatory approval by the FDA. Further, clinical trials by their nature utilize a sample of the potential patient population. With a limited number of subjects and limited duration of exposure, rare and severe side effects of our product candidates may only be uncovered with a significantly larger number of patients exposed to the drug. Undesirable side effects could also result in an expansion in the size of our clinical trials, increasing the expected costs and timeline of our clinical trials. Additionally, results of our clinical trials could reveal a high and unacceptable severity and prevalence of side effects or unexpected characteristics.

Licensed CAR T cell therapies and those under development have shown frequent rates of CRS and neurotoxicity, and adverse events have resulted in the death of patients. Similar adverse events could occur during treatment with our CAAR T cell product candidates. For example, activation of CAAR T cells by patient autoantibodies or alloantibodies could stimulate CRS. When CAAR T cells are infused and the CAAR binds to soluble antibodies in the blood or tissues of treated patients, these soluble antibodies may cause the CAAR T cells to proliferate, resulting in an activation of the immune system that is too high, leading to CRS. Further, it is possible that patients will exhibit acute rejection of the CAAR T cells because of preexisting immunity to the antigen within the CAAR. This could render our product candidates ineffective.

If unacceptable toxicities or health risks, including risks inferred from other unrelated immunotherapy trials, arise in the development of our product candidates, we could suspend or terminate our trials or the FDA, the Data Safety Monitoring Board, or DSMB, or local regulatory authorities such as institutional review boards, or IRBs, could order us to cease clinical trials. Regulatory authorities, such as the FDA, could also deny approval of our product candidates for any or all targeted indications. Treatment-related side effects could also affect patient recruitment or the ability of enrolled subjects to complete the trial or result in potential product liability claims. In addition, these side effects may not be appropriately recognized or managed by the treating medical staff, as toxicities resulting from T cell therapy are not normally encountered in the general patient population and by medical personnel. We expect to have to train medical personnel using CAAR T cell product candidates to understand the side effect profile of our product candidates for both our preclinical studies and clinical trials and upon any commercialization of any of our product candidates, if licensed. Inadequate training in recognizing or managing the potential side effects of our product candidates could result in patient deaths. Any of these occurrences may harm our business, financial condition and prospects significantly.

Our preclinical studies and clinical trials may fail to demonstrate the safety, potency and purity of any of our product candidates, which would prevent or delay regulatory approval and commercialization.

Before obtaining regulatory approvals for the commercial sale of any of our product candidates, we must demonstrate through lengthy, complex and expensive preclinical testing and clinical trials that our product candidates are safe, potent and pure for use in each target indication. Clinical trials are expensive and can take many years to complete, and their outcomes are inherently uncertain. Failure can occur at any time during the clinical trial process. The results of preclinical studies and early clinical trials of our product candidates may not be predictive of the results of later-stage clinical trials, including in any post-approval studies of our product candidates. In addition, initial success in any clinical trials may not be indicative of results obtained when such trials are completed. There is typically an extremely high rate of attrition from the failure of product candidates proceeding through clinical trials. Product candidates in later stages of clinical trials may fail to show the desired safety, potency and purity profile despite having progressed through preclinical studies and initial clinical trials.

A number of companies in the biopharmaceutical industry have suffered significant setbacks in advanced clinical trials due to lack of potency or efficacy, insufficient durability of potency or efficacy or unacceptable safety issues, notwithstanding promising results in earlier trials, and we cannot be certain that we will not face similar setbacks. These setbacks have been caused by, among other things, preclinical and other nonclinical findings made while clinical trials were underway, or safety or efficacy observations made in preclinical studies and clinical trials, including previously unreported adverse events. Moreover, preclinical and clinical data are often susceptible to varying interpretations and analyses and many companies that believed their product candidates performed satisfactorily in preclinical studies and clinical trials nonetheless failed to obtain FDA or EMA approval. Most product candidates that commence clinical trials are never approved as products.

Any preclinical studies or clinical trials that we may conduct may not demonstrate the safety, potency and purity necessary to obtain regulatory approval to market our product candidates. If the results of our ongoing or future preclinical studies and clinical trials are inconclusive with respect to the safety, potency and purity of our product candidates, if we do not meet the clinical endpoints with statistical and clinically meaningful significance, or if there are safety concerns associated with our product candidates, we may be prevented or delayed in obtaining marketing approval for such product candidates. In some instances, there can be significant variability in safety, potency or purity results between different preclinical studies and clinical trials of the same product candidate due to numerous factors, including changes in trial procedures set forth in protocols, differences in the size and type of the patient populations, changes in and adherence to the clinical trial protocols and the rate of dropout among clinical trial participants. For example, because our CAAR T cell product candidates only target approximately 0.01% to 1% of the B cells in a patient, they may not engage enough of the target to achieve adequate engraftment necessary for elimination of all pathogenic B cells. Insufficient safety or potency in clinical trials may delay product development to enable time to modify the product candidate for next generation approaches or make manufacturing changes or may lead us to discontinue development of the product candidate.

Additionally, our ongoing DesCAARTes™ trial utilizes, and our planned trials may utilize, an “open-label” trial design. An “open-label” clinical trial is one where both the patient and investigator know whether the patient is receiving the investigational product candidate or either an active drug or placebo. Most typically, open-label clinical trials test only the investigational product candidate and sometimes may do so at different dose levels. Open-label clinical trials are subject to various limitations that may exaggerate any therapeutic effect as patients in open-label clinical trials are aware when they are receiving treatment. Open-label clinical trials may be subject to a “patient bias” where patients perceive their symptoms to have improved merely due to their awareness of receiving an experimental treatment. In addition, open-label clinical trials may be subject to an “investigator bias” where those assessing and reviewing the physiological outcomes of the clinical trials are aware of which patients have received treatment and may interpret the information of the treated group more favorably given this knowledge. The results from an open-label trial may not be predictive of future clinical trial results with any of our product candidates for which we include an open-label clinical trial when studied in a controlled environment with a placebo or active control.

In addition, for DSG3-CAART, MuSK-CAART and any future trials that may be completed, we cannot guarantee that the FDA will interpret the results as we do, and more trials could be required before we submit our product candidates for approval. To the extent that the results of the trials are not satisfactory to the FDA to support a marketing application, approval of our product candidates may be significantly delayed, or we may be required to expend significant additional resources, which may not be available to us, to conduct additional trials in support of potential approval of our product candidates.

Interim, topline or preliminary data from any preclinical studies or clinical trials that we conduct may change as more data become available and are subject to audit and verification procedures that could result in material changes in the final data.

Our initial clinical trial for our lead product candidate will be open-label. From time to time, we may publicly disclose preliminary or topline or data from our preclinical studies and clinical trials, which will be based on a preliminary analysis of then-available data, and the results and related findings and conclusions are subject to change following a more comprehensive review of the data related to the particular study or trial. We also make assumptions, estimations, calculations and conclusions as part of our analyses of data, and we may not have received or had the opportunity to fully and carefully evaluate all data. Additionally, in our DesCAARTes™ trial, the product candidate will be administered by intravenous infusion, using a fractionated-dose infusion scheme of escalating numbers of DSG3-CAART cells.

As a result, the topline results that we report may differ from future results of the same studies, or different conclusions or considerations may qualify such results, once additional data have been received and fully evaluated. Topline data also remain subject to audit and verification procedures that may result in the final data being materially different from the preliminary data we previously published. As a result, topline data should be viewed with caution until the final data are available. From time to time, we may also disclose interim data from planned interim analyses in our clinical trials. Interim data from clinical trials that we may complete are subject to the risk that one or more of the clinical outcomes may materially change as patient enrollment continues and more patient data become available. Adverse differences between preliminary or interim data and final data could significantly harm our business prospects. Further, disclosure of interim data by us or by our competitors could result in volatility in the price of our common stock.

Regulatory agencies, including the FDA, may not accept or agree with our assumptions, estimates, calculations, conclusions or analyses or may interpret or weigh the importance of data differently, which could impact the value of the particular program, the approvability or commercialization of the particular product candidate or product and our company in general.

If the interim, topline or preliminary data that we report differ from actual results, or if others, including regulatory authorities, disagree with the conclusions reached, our ability to obtain approval for, and commercialize, our product candidates may be harmed, which could harm our business, operating results, prospects or financial condition.

We may encounter substantial delays in our clinical trials or may not be able to conduct our trials on the timelines we expect or at all.

Clinical testing is expensive, time consuming and subject to uncertainty. We cannot guarantee that any clinical trials will be conducted as planned or completed on schedule, if at all. Even if these trials begin as planned, issues may arise that could suspend or terminate such clinical trials. A failure of one or more clinical trials can occur at any stage of testing, and our ongoing and future clinical trials may not be successful. Events that may prevent successful or timely completion of clinical development include:

- inability to generate sufficient preclinical, toxicology or other *in vivo* or *in vitro* data to support the initiation of clinical trials;
- delays in sufficiently developing, characterizing or controlling a manufacturing process suitable for clinical trials;
- delays in developing suitable assays for screening patients for eligibility for clinical trials with respect to certain product candidates;
- delays in reaching a consensus with the FDA and other regulatory agencies on trial design;
- delays in reaching agreement on acceptable terms with prospective CROs and clinical study sites, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs and clinical trial sites;
- delays in obtaining required institutional review board, or IRB, approval at each clinical trial site;
- imposition of a temporary or permanent clinical hold by regulatory agencies for a number of reasons, including after review of an IND submission or amendment, or equivalent application or amendment; as a result of a new safety finding that presents unreasonable risk to clinical trial participants; a negative finding from an inspection of our clinical study operations or study sites; developments on trials conducted by competitors for related technology that raises FDA concerns about risk to patients of the technology broadly; or if FDA finds that the investigational protocol or plan is clearly deficient to meet its stated objectives;
- delays in recruiting eligible patients to participate in our clinical trials;
- delays in treating one or more patients, once enrolled, due to a patient's inability to accommodate parts of the complex study procedures schedule;
- difficulty collaborating with patient groups and investigators;
- failure by our CROs, other third parties or us to adhere to clinical trial requirements;
- limitations on our recourse in our CRO relationship with Penn as compared to a CRO that is not an academic institution;
- failure to perform in accordance with the FDA's good clinical practice, or GCP, requirements or applicable regulatory guidelines in other countries;
- transfer of manufacturing processes to any new CMO or our own manufacturing facilities or any other development or commercialization partner for the manufacture of product candidates;

- delays in having patients complete participation in a trial or return for post-treatment follow-up;
- patients dropping out of a trial;
- occurrence of adverse events associated with the product candidate that are viewed to outweigh its potential benefits;
- changes in regulatory requirements and guidance that require amending or submitting new clinical protocols;
- changes in the standard of care on which a clinical development plan was based, which may require new or additional trials;
- the cost of clinical trials of our product candidates being greater than we anticipate;
- clinical trials of our product candidates producing negative or inconclusive results, which may result in our deciding, or regulators requiring us, to conduct additional clinical trials or abandon product development programs;
- delays or failure to secure supply agreements with suitable raw material suppliers, or any failures by suppliers to meet our quantity or quality requirements for necessary raw materials; and
- delays in manufacturing, testing, releasing, validating or importing/exporting sufficient stable quantities of our product candidates for use in clinical trials or the inability to do any of the foregoing.

Any inability to successfully complete preclinical and clinical development could result in additional costs to us or impair our ability to generate revenue. In addition, if we make manufacturing or formulation changes to our product candidates, we may be required to, or we may elect to, conduct additional trials to bridge our modified product candidates to earlier versions. Clinical trial delays could also shorten any periods during which our product candidates and products, if licensed, have patent protection and may allow our competitors to bring products to market before we do, which could impair our ability to successfully commercialize our product candidates and may harm our business and results of operations.

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

Delays in the initiation, conduct or completion of any clinical trial of our product candidates will increase our costs, slow down our product candidate development and approval process and delay or potentially jeopardize our ability to commence product sales and generate revenue. 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. In the event we identify any additional product candidates to pursue, we cannot be sure that submission of an IND will result in the FDA allowing clinical trials to begin in a timely manner, if at all. Any of these occurrences may significantly harm our business, financial condition and prospects.

Monitoring safety of patients receiving our product candidates will be challenging, which could adversely affect our ability to obtain regulatory approval and commercialize our product candidates.

For our clinical trials of DSG3-CAART and our other product candidates, we expect to continue to contract with Penn and other academic medical centers and hospitals experienced in the assessment and management of toxicities arising during clinical trials. In the future, we may also contract with non-academic medical centers and hospitals with similar capabilities. Nonetheless, these centers and hospitals may have difficulty observing patients, including due to failure by patients to comply with post-clinical trial follow-up programs, and treating toxicities,

which may be more challenging due to personnel changes, inexperience, shift changes, house staff coverage or related issues. This could lead to more severe or prolonged toxicities or even patient deaths, which could result in us or the FDA delaying, suspending or terminating one or more of our clinical trials, and which could jeopardize regulatory approval. We also expect the centers using DSG3-CAART and our other product candidates, if licensed, on a commercial basis could have similar difficulty in managing adverse events. Medicines used at centers to help manage adverse side effects of DSG3-CAART and our other product candidates may not adequately control the side effects and/or may have a detrimental impact on the efficacy of the treatment.

If we encounter difficulties enrolling patients in our clinical trials, our clinical development activities could be delayed or otherwise adversely affected.

We may experience difficulties in patient enrollment in our clinical trials for a variety of reasons. The timely completion of clinical trials in accordance with their protocols depends, among other things, on our ability to enroll a sufficient number of patients who remain in the trial until its conclusion. The enrollment of patients depends on many factors, including:

- the size and nature of the patient population;
- the patient eligibility criteria defined in the protocol;
- the size of the patient population required for analysis of the trial's primary endpoints;
- recruiting an adequate number of suitable patients to participate in a clinical trial;
- reaching agreement on acceptable terms with prospective CROs and clinical trial sites, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs and clinical trial sites;
- obtaining IRB and other required reviewing body approval at each clinical trial site;
- the proximity of patients to trial sites;
- the design of the trial and whether the FDA agrees to the design and implementation of the trial;
- our ability to identify clinical trial sites and recruit clinical trial investigators with the appropriate capabilities, competencies and experience;
- clinicians' and patients' perceptions as to the potential advantages and risks of the product candidate being studied in relation to other available therapies, including any new drugs that may be approved for the indications we are investigating;
- the occurrence of dose-limiting toxicity in the clinical trial;
- the efforts to facilitate timely enrollment in clinical trials;
- the patient referral practices of physicians;
- the ability to monitor patients adequately during and after treatment;
- our ability to obtain and maintain patient consents;
- the risk that patients enrolled in clinical trials will drop out of the trials before the infusion of our product candidates or trial completion; and
- the ability of patients to meet the complex follow-up requirements of the clinical trial.

In addition, our clinical trials will compete with other clinical trials for product candidates that are in the same therapeutic areas as our product candidates, and this competition will reduce the number and types of patients available to us because some patients who might have opted to enroll in our trials may instead opt to enroll in a trial being conducted by one of our competitors. Since the number of qualified clinical investigators is limited, some of our clinical trial sites may also be used by some of our competitors, which may reduce the number of patients who are available for our clinical trials in that clinical trial site.

Moreover, because our product candidates represent a departure from more commonly used methods for B cell-mediated autoimmune disease treatment, potential patients and their doctors may be inclined to use conventional therapies, such as corticosteroids or systemic immunosuppressive medications, rather than enroll patients in our clinical trial.

Delays in patient enrollment may result in increased costs or may affect the timing or outcome of our ongoing and planned clinical trials, which could prevent completion of these trials and adversely affect our ability to advance the development of our product candidates.

Our DesCAARTes™ trial and additional expected Phase 1 clinical trials for each of our product candidates will be pilot dose escalation studies with a limited number of patients. The activity and toxicity data from these clinical trials of our product candidates may differ from future results of Phase 2 and/or Phase 3 clinical trials that enroll a larger number of patients.

Since the number of patients that we plan to dose in our DesCAARTes™ trial is small, the results from such clinical trial, once completed, may be less reliable than results achieved in larger clinical trials, which may hinder our efforts to obtain regulatory approval for our product candidates. In our DesCAARTes™ trial, we plan to evaluate the toxicity profile of DSG3-CAART and establish the recommended dose for the next clinical trial. The preliminary results of clinical trials with smaller sample sizes, such as our DesCAARTes™ trial, can be disproportionately influenced by various biases associated with the conduct of small clinical trials, such as the potential failure of the smaller sample size to accurately depict the features of the broader patient population, which limits the ability to generalize the results across a broader community, thus making the clinical trial results less reliable than clinical trials with a larger number of patients. As a result, there may be less certainty that such product candidates would achieve a statistically significant effect in any future clinical trials. If we conduct any future clinical trials of DSG3-CAART, we may not achieve a statistically significant result or the same level of statistical significance, if any, that we might have anticipated based on the results observed in our DesCAARTes™ trial.

Risks Related to Sales, Marketing and Competition

The market opportunities for our product candidates may be limited to those patients who are ineligible for or have failed prior treatments and may be small.

Our projections of both the number of people who have the B cell-mediated autoimmune diseases we are targeting, as well as the subset of people with these diseases in a position to receive second or later lines of therapy and who have the potential to benefit from treatment with our product candidates, are based on our beliefs and estimates. These estimates have been derived from a variety of sources, including scientific literature, surveys of clinics, patient foundations, or market research and may prove to be incorrect. Further, new studies may change the estimated incidence or prevalence of these B cell-mediated autoimmune diseases. The number of patients may turn out to be lower than expected. Additionally, the potentially addressable patient population for our product candidates may be limited or may not be amenable to treatment with our product candidates. For instance, we expect our lead product candidate, DSG3-CAART, to initially target a small patient population that suffers from mPV. Even if we obtain significant market share for our product candidates, because the potential target populations are small, we may never achieve profitability without obtaining regulatory approval for additional indications.

We face significant competition from other biotechnology and pharmaceutical companies, and our operating results will suffer if we fail to compete effectively.

The biopharmaceutical and pharmaceutical industries are characterized by rapidly advancing technologies, intense competition and a strong focus on intellectual property. We face competition from many different players, including large and specialty pharmaceutical and biotechnology companies, academic research organizations and governmental agencies. Any therapeutic candidates we successfully develop and commercialize will compete with the existing standard of care as well as novel therapies that may gain regulatory approval in the future. Many of our competitors have substantially greater financial, technical and other resources, such as larger research and development staff and experienced marketing and manufacturing organizations and well-established sales forces. Smaller or early-stage companies may also prove to be significant competitors, particularly through collaborative arrangements with large, established companies. Mergers and acquisitions in the biotechnology and pharmaceutical

industries may result in even more resources being concentrated in our competitors. We believe we are the first and only company developing CAAR T drug candidates for the treatment of B cell-mediated autoimmune diseases. However, despite the significant differences in discovery, development and target populations between oncology and autoimmune targets, we recognize that companies with an investment and expertise in CAR T cell development for oncology indications could attempt to leverage their expertise into B cell-mediated autoimmune disease affected populations. Competition may increase further as a result of advances in the commercial applicability of technologies and greater availability of capital for investment in these industries. Our competitors, either alone or with collaborative partners, may succeed in developing, acquiring or licensing on an exclusive basis drug or biologic products that are more effective, safer, more easily commercialized or less costly than our product candidates or may develop proprietary technologies or secure patent protection that we may need for the development of our technologies and products.

Specifically, while rituximab is the first drug for the treatment of PV, the target indication of our lead product candidate, DSG3-CAART, to have received regulatory approval in the United States in over 60 years, we are aware that multiple biopharmaceutical companies have therapies in clinical development. We are also aware of other biopharmaceutical companies developing therapies for muscle-specific kinase myasthenia gravis, or MuSK MG, and Hemophilia A patients who develop alloantibodies against FVIII. While we do not expect these product candidates to be directly competitive to our product candidates, even if we obtain regulatory approval of our product candidates, the availability and price of these other products could limit the demand and the price we are able to charge for our product candidates. We may not be able to implement our business plan if the acceptance of our product candidates is inhibited by price competition or the reluctance of physicians to switch from existing methods of treatment to our product candidates, or if physicians switch to other new drug or biologic products or choose to reserve our product candidates for use in limited circumstances.

Even if we obtain regulatory approval of our product candidates, the products may not gain the market acceptance among physicians, patients, hospitals, treatment centers and others in the medical community necessary for commercial success.

The use of engineered T cells as a potential treatment for B cell-mediated autoimmune diseases is a recent development and may not become broadly accepted by physicians, patients, hospitals, treatment centers and others in the medical community. We expect physicians to be particularly influential and we may not be able to convince them to use our product candidates for many reasons. Additional factors will influence whether our product candidates are accepted in the market, including:

- the clinical indications for which our product candidates are licensed;
- physicians, hospitals, treatment centers and patients considering our product candidates as a safe and effective treatment;
- the potential and perceived advantages of our product candidates over alternative treatments;
- the prevalence and severity of any side effects;
- product labeling or product insert requirements of the FDA or other regulatory authorities;
- limitations or warnings contained in the labeling approved by the FDA;
- the timing of market introduction of our product candidates as well as competitive products;
- the cost of treatment in relation to alternative treatments;
- the availability of coverage and adequate reimbursement and pricing by third-party payors and government authorities;
- the willingness of patients to pay out-of-pocket in the absence of coverage and adequate reimbursement by third-party payors and government authorities;
- relative convenience and ease of administration, including as compared to alternative treatments and competitive therapies; and
- the effectiveness of our sales and marketing efforts.

The product candidates we plan to develop and commercialize are premised on offering a potential cure for B cell-mediated autoimmune diseases, which may result in a high degree of uncertainty related to pricing and long-term demand for our product. Our target patient populations are relatively small. Because of this pricing and demand for our product candidates, if licensed, may not be adequate to support an extended period of commercial viability, which could adversely affect our continued ability to successfully produce and market our product or any follow-on products.

In addition, if our product candidates are licensed but fail to achieve market acceptance among physicians, patients, hospitals, treatment centers or others in the medical community, we will not be able to generate significant revenue. Even if our products achieve market acceptance, we may not be able to maintain that market acceptance over time if new products or technologies are introduced that are more favorably received than our products, are more cost effective or render our products obsolete.

Risks Related to Business Development

We may not be successful in our efforts to identify additional product candidates. Due to our limited resources and access to capital, we must prioritize development of certain product candidates, which may prove to be wrong and may adversely affect our business.

Although we intend to explore other therapeutic opportunities, in addition to the product candidates that we are currently developing, we may fail to identify viable new product candidates for clinical development for a number of reasons. If we fail to identify additional potential product candidates, our business could be materially harmed.

Research programs to pursue the development of our existing and planned product candidates for additional indications and to identify new product candidates and disease targets require substantial technical, financial and human resources whether or not they are ultimately successful. Our research programs may initially show promise in identifying potential indications and/or product candidates, yet fail to yield results for clinical development for a number of reasons, including:

- the research methodology used may not be successful in identifying potential indications and/or product candidates;
- potential product candidates may be identified but may not be able to be expressed on T cells in a manner that enables product activity;
- potential product candidates may, after further study, be shown to have harmful adverse effects or other characteristics that indicate they are unlikely to be effective drugs; or
- it may take greater human and financial resources than we will possess to identify additional therapeutic opportunities for our product candidates or to develop suitable potential product candidates through internal research programs, thereby limiting our ability to develop, diversify and expand our product portfolio.

Because we have limited financial and human resources, we intend to initially focus on research programs and product candidates for a limited set of indications. As a result, we may forego or delay pursuit of opportunities with other product candidates or for other indications that later prove to have greater commercial potential or a greater likelihood of success. Our resource allocation decisions may cause us to fail to capitalize on viable commercial products or profitable market opportunities.

Accordingly, there can be no assurance that we will ever be able to identify additional therapeutic opportunities for our product candidates or to develop suitable potential product candidates through internal research programs, which could materially adversely affect our future growth and prospects. We may focus our efforts and resources on potential product candidates or other potential programs that ultimately prove to be unsuccessful.

If we fail to develop additional product candidates, our commercial opportunity will be limited.

One of our core strategies is to pursue clinical development of additional product candidates beyond DSG3-CAART, MuSK-CAART, DSG3/1-CAART and FVIII-CAART. Developing, obtaining regulatory approval and commercializing additional CAAR T cell product candidates will require substantial additional funding and is prone to the risks of failure inherent in medical product development. We cannot provide you any assurance that we will be able to successfully advance any of these additional product candidates through the development process.

Even if we receive FDA approval to market additional product candidates for the treatment of B cell-mediated autoimmune diseases, we cannot assure you that any such product candidates will be successfully commercialized, widely accepted in the marketplace or more effective than other commercially available alternatives. If we are unable to successfully develop and commercialize additional product candidates, our commercial opportunity will be limited. Moreover, a failure in obtaining regulatory approval of additional product candidates may have a negative effect on the approval process of any other, or result in losing approval of any approved, product candidate.

We are highly dependent on our key personnel, and if we are not successful in attracting and retaining highly qualified personnel, we may not be able to successfully implement our business strategy.

Our ability to compete in the highly competitive biotechnology and pharmaceutical industries depends upon our ability to attract and retain highly qualified managerial, scientific and medical personnel. We are highly dependent on our management, scientific, and medical personnel, including our Chief Executive Officer and President, our Scientific Advisory Board members, our Chief Medical Officer, our Executive Vice President, Science and Technology, and our Chief Financial Officer. The loss of the services of any of our executive officers, other key employees, and other scientific and medical advisors, and our inability to find suitable replacements could result in delays in product development and harm our business.

Competition for skilled personnel in our market is intense and may limit our ability to hire and retain highly qualified personnel on acceptable terms or at all. To induce valuable employees to remain at our company, in addition to salary and cash incentives, we have provided stock options that vest over time. The value to employees of stock options that vest over time may be significantly affected by movements in our stock price that are beyond our control and may at any time be insufficient to counteract more lucrative offers from other companies. Despite our efforts to retain valuable employees, members of our management, scientific and development teams may terminate their employment with us on short notice. Although we have employment agreements with our key employees, these employment agreements provide for at-will employment, which means that any of our employees could leave our employment at any time, with or without notice. We do not maintain "key person" insurance policies on the lives of these individuals or the lives of any of our other employees. Our success also depends on our ability to continue to attract, retain and motivate highly skilled junior, mid-level and senior managers as well as junior, mid-level and senior scientific and medical personnel.

We expect to grow the size of our organization, and we may experience difficulties in managing this growth.

As of December 31, 2020, we had 33 full-time employees and one part-time employee. As our development and commercialization plans and strategies develop, and as we continue to transition into operating as a public company, we expect to rapidly expand our employee base and continue to add managerial, operational, sales, research and development, marketing, financial and other personnel. For example, we are still dependent on Penn and certain Penn-affiliated entities to continue providing certain research and development as well as manufacturing services under that certain research services agreement. Current and future growth imposes significant added responsibilities on members of management, including:

- identifying, recruiting, integrating, maintaining and motivating additional employees;
- managing our internal development efforts effectively, including the clinical and FDA review process for our product candidates, while complying with our contractual obligations to contractors and other third parties; and
- improving our operational, financial and management controls, reporting systems and procedures.

Our future financial performance and our ability to commercialize our product candidates will depend, in part, on our ability to effectively manage our growth, and our management may also have to divert a disproportionate amount of its attention away from day-to-day activities in order to devote a substantial amount of time to managing these growth activities.

We currently rely, and for the foreseeable future will continue to rely, in substantial part on certain independent organizations, advisors and consultants to provide certain services, including certain research and development as well as general and administrative support, pursuant to agreements which expire after a certain period of time. There can be no assurance that the services of independent organizations, advisors and consultants will continue to be available to us on a timely basis when needed, or that we can find qualified replacements. In addition, if we are unable to effectively manage our outsourced activities or if the quality or accuracy of the services provided by consultants is compromised for any reason, our clinical trials may be extended, delayed or terminated, and we may not be able to obtain regulatory approval of our product candidates or otherwise advance our business. There can be no assurance that we will be able to manage our existing consultants or find other competent outside contractors and consultants on economically reasonable terms, or at all.

If we are not able to effectively expand our organization by hiring new employees and expanding our groups of consultants and contractors, or if we are not able to raise sufficient funds in the future to support our hiring efforts beyond our research and development personnel, we may not be able to successfully implement the tasks necessary to further develop and commercialize our product candidates and, accordingly, may not achieve our research, development and commercialization goals.

Business disruptions could seriously harm our future revenue and financial condition and increase our costs and expenses.

Our operations, Penn's operations and those of any CMOs, CROs and other contractors and consultants that we may engage could be subject to earthquakes, power shortages, telecommunications failures, water shortages, floods, hurricanes, typhoons, fires, extreme weather conditions, medical epidemics and other natural or man-made disasters or business interruptions, for which we are predominantly self-insured. The occurrence of any of these business disruptions could seriously harm our operations and financial condition and increase our costs and expenses. We currently rely on Penn to produce and process our first product candidate and anticipate that in the future we will rely on a third-party CMO for the same. Our ability to obtain clinical supplies of our product candidates could be disrupted if the operations of these suppliers are affected by a man-made or natural disaster or other business interruption.

In addition, due to the COVID-19 pandemic, our increased reliance on personnel working from home may negatively impact productivity, or disrupt, delay, or otherwise adversely impact our business operations. Further, this could increase our cyber security risk, create data accessibility concerns, and make us more susceptible to communication disruptions, any of which could adversely impact our business operations or delay necessary

interactions with local and federal regulators, ethics committees, manufacturing sites, research or clinical trial sites and other important agencies and contractors.

Risks Related to Litigation

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

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

- inability to bring our product candidates to the market;
- decreased demand for our product candidates;
- injury to our reputation;
- withdrawal of clinical trial participants;
- initiation of investigations by regulators;
- costs to defend the related litigation;
- a diversion of management's time and our resources;
- substantial monetary awards to trial participants or patients;
- product recalls, withdrawals or labeling, marketing or promotional restrictions;
- loss of revenue;
- exhaustion of any available insurance and our capital resources;
- the inability to commercialize any product candidate; and
- a decline in our share price.

Since we have not yet commenced marketing of any products, we do not yet hold product liability insurance for commercialization of our product candidates. Our inability to obtain sufficient product liability insurance at an acceptable cost to protect against potential product liability claims could prevent or inhibit the commercialization of products we develop, alone or with corporate collaborators. Our insurance policies may also have various exclusions, and we may be subject to a product liability claim for which we have no coverage. Assuming we obtained clinical trial insurance for our clinical trials, we may have to pay amounts awarded by a court or negotiated in a settlement that exceed our coverage limitations or that are not covered by our insurance, and we may not have, or be able to obtain, sufficient capital to pay such amounts. Even if our agreements with any future corporate collaborators entitle us to indemnification against losses, such indemnification may not be available or adequate should any claim arise.

Risks Related to Our Financial Condition and Capital Requirements

Risks Related to Past Financial Condition

We have incurred net losses in every period since our inception and anticipate that we will incur substantial net losses over the next several years, and may never achieve or maintain profitability.

Investment in biopharmaceutical product development is highly speculative because it entails substantial upfront capital expenditures and significant risk that any potential product candidate will fail to demonstrate adequate effect or an acceptable safety profile, gain regulatory approval and become commercially viable. We have only recently licensed rights to the patents underlying our product candidates and initiated our DesCAARTes™ trial in June 2020. We have no products licensed for commercial sale, and we will continue to incur significant research and development and other expenses related to our ongoing operations. Our net losses may fluctuate significantly from quarter to quarter and year to year. We have to date financed our operations primarily through private placements of our preferred stock.

As a result, we are not profitable and have incurred net losses in each period since our inception. For the years ended December 31, 2020 and 2019, we recorded net losses of \$33.3 million and \$16.9 million, respectively. As of December 31, 2020, we had an accumulated deficit of \$66.3 million. We expect to incur significant losses for the foreseeable future, and we expect these losses to increase substantially if, and as, we:

- continue our research and development efforts and submit additional Investigational New Drug applications, or INDs, for our product candidates;
- conduct preclinical studies and clinical trials for our current and future product candidates;
- further develop our product candidate platform;
- continue to discover and develop additional product candidates;
- maintain, expand and protect our intellectual property portfolio;
- hire additional clinical, scientific manufacturing and commercial personnel;
- establish a commercial manufacturing source and secure supply chain capacity sufficient to provide commercial quantities of any product candidates for which we may obtain regulatory approval, whether through a contract manufacturing organization, or CMO, or through a manufacturing facility that we establish;
- acquire or in-license other product candidates and technologies, including advanced manufacturing and translational capabilities that we will need for the further development and possible commercialization of our product candidates;
- seek marketing approvals for any product candidates that successfully complete clinical trials;
- establish a sales, marketing and distribution infrastructure to support the sales and marketing of any product candidates for which we may obtain marketing approvals; and
- add operational, financial and management information systems and personnel, including personnel to support our product development and planned future commercialization efforts, as well as to support our transition to a public company.

To become and remain profitable, we must succeed in developing, and eventually commercializing, a product or products that generate significant revenue. The ability to achieve this success will require us to be effective in a range of challenging activities, including completing preclinical testing and clinical trials of our product candidates, discovering additional product candidates, obtaining regulatory approval for these product candidates and manufacturing, marketing and selling any products for which we may obtain regulatory approval. We are only in the preliminary stages of most of these activities and have not yet demonstrated our ability to successfully develop any product candidate, obtain regulatory approvals, manufacture a commercial scale product or arrange for a third party to do so on our behalf, or conduct sales and marketing activities necessary for successful product commercialization. We may never be able to develop, manufacture or commercialize a marketable product.

Even if we are able to succeed in these activities, we may never generate revenues that are significant enough to achieve profitability. Because of the numerous risks and uncertainties associated with pharmaceutical product development, we are unable to accurately predict the timing or amount of increased expenses or when, or if, we will be able to achieve profitability. Our expenses will increase if, among other things:

- there are any delays in completing our clinical trials or the development of any of our product candidates;
- we are required by the FDA or other regulatory authorities to perform trials or studies in addition to, or different than, those expected; or
- there are any third-party challenges to our intellectual property or we need to defend against any intellectual property-related claim.

Because of the numerous risks and uncertainties associated with pharmaceutical product development, we are unable to accurately predict the timing or amount of increased expenses we will incur or when, if ever, we will be able to achieve profitability. Even if we succeed in commercializing one or more of our product candidates, we will continue to incur substantial research and development and other expenditures to develop, seek regulatory approval for and market additional product candidates. We may encounter unforeseen expenses, difficulties, complications, delays and other unknown factors that may adversely affect our business. The size of our future net losses will depend, in part, on the rate of future growth of our expenses and our ability to generate revenue. Our prior losses and expected future losses have had and will continue to have an adverse effect on our stockholders' equity and working capital.

We have a limited operating history, which may make it difficult to evaluate the success of our business to date and to assess our future viability, and we may face significant challenges and expense as we test our product candidates and build our capabilities.

We were incorporated in 2017 and initially acquired rights to license certain patent rights Penn in August 2018. We are early in our development efforts, have a limited operating history and are subject to the risks inherent to any newly-formed organization, including, among others, risks that we may not be able to hire sufficient qualified personnel and establish operating controls and procedures.

Our limited operating history, particularly in light of the rapidly evolving cell therapy field, may make it difficult to evaluate our technology and industry and predict our future performance. Our short history as an operating company makes any assessment of our future success or viability subject to significant uncertainty. We will encounter risks and difficulties frequently experienced by early-stage companies in rapidly evolving fields. If we do not address these risks successfully, our business will suffer. Similarly, we expect that our financial condition and operating results will fluctuate significantly from quarter to quarter and year to year due to a variety of factors, many of which are beyond our control. As a result, our shareholders should not rely upon the results of any quarterly or annual period as an indicator of future operating performance.

We currently do not have in-house resources sufficient to enable our chimeric autoantibody receptor, or CAAR, T cell platform. We are reliant on several manufacturing and support services from Penn through a Master Translational Research Services Agreement, or the Services Agreement, as well as certain research and development and general and administrative services through two sponsored research agreements. We also rely on Penn for access to key technologies for current manufacturing of our product candidates. As we build our own capabilities, and enter into agreements with third parties, we expect to encounter risks and uncertainties frequently experienced by growing companies in new and rapidly evolving fields, including the risks and uncertainties described herein. Our ability to rely on services from Penn is limited to a specified period of time, to specific capabilities, and is subject to Penn's right to terminate these services with or without cause. If we are unable to establish necessary relationships with third party partners and build our own capabilities, our operating and financial results could differ materially from our expectations, and our business could suffer.

All of our programs require additional preclinical research and development, clinical development, regulatory approval in multiple jurisdictions, obtaining manufacturing supply, capacity and expertise, building of a commercial organization, substantial investment and significant marketing efforts before we generate any revenue from product sales. Other programs of ours require additional discovery research and then preclinical and clinical development. In

addition, our product candidates must be licensed for marketing by the FDA before we may commercialize any product.

In addition, as an early-stage company, we have encountered and may continue to encounter unforeseen expenses, difficulties, complications, delays and other known and unknown circumstances. As we advance our product candidates, we will need to transition from a company with a research focus to a company capable of supporting clinical development and if successful, commercial activities. We may not be successful in such a transition.

We have not generated any revenue from our product candidates and our ability to generate revenue from product sales and become profitable depends significantly on our success in a number of areas.

To become and remain profitable, we or any potential future collaborator must develop and eventually commercialize products with significant market potential at an adequate profit margin after cost of goods sold and other expenses. All of our product candidates are in the early stages of development and we will require additional preclinical studies, clinical development, regulatory review and approval, substantial investment, access to sufficient commercial manufacturing capacity and significant marketing efforts before we can generate any revenue from product sales. We initiated our DesCAARTes™ trial of DSG3-CAART, our most advanced product candidate, targeting pathogenic B cells in patients with mucosal pemphigus vulgaris, or mPV, in June 2020. Our other product candidates, which include DSG3/1-CAART, targeting pathogenic B cells in patients with mucocutaneous pemphigus vulgaris, or mcPV, MuSK-CAART, targeting pathogenic B cells in a subset of patients with myasthenia gravis, or MG, and FVIII-CAART, for potential use as an adjunctive therapy targeting a subset of patients with Hemophilia A who develop alloantibody resistance to Factor VIII, or FVIII, replacement therapy, have yet to complete IND-enabling studies. We have not yet administered any of our product candidates in humans and, as such, we face significant translational risk as our product candidates advance to the clinical stage. Our ability to generate revenue depends on a number of factors, including, but not limited to:

- timely completion of our preclinical studies and clinical trials, which may be significantly slower or cost more than we currently anticipate and will depend substantially upon the performance of third-party academic and commercial contractors;
- our ability to complete IND-enabling studies and successfully submit INDs or comparable applications;
- whether we are required by the FDA to conduct additional clinical trials or other studies beyond those planned to support the licensure and commercialization of our product candidates or any future product candidates;
- our ability to demonstrate to the satisfaction of the FDA the safety, potency, purity and acceptable risk to benefit profile of our product candidates or any future product candidates;
- the prevalence, duration and severity of potential side effects or other safety issues experienced with our product candidates or future product candidates, if any;
- the cost of manufacturing and processing our product candidates being greater than we anticipate;
- the timely receipt of necessary marketing approvals from the FDA;
- the willingness of physicians, operators of clinics and patients to utilize or adopt any of our product candidates or future product candidates to treat B cell-mediated autoimmune diseases;
- our ability and the ability of third parties with whom we contract to manufacture adequate clinical and commercial supplies of our product candidates or any future product candidates, remain in good standing with regulatory authorities and develop, validate and maintain commercially viable manufacturing processes that are compliant with current Good Manufacturing Practices, or cGMP;
- our ability to successfully develop a commercial and competitive strategy and thereafter commercialize our product candidates or any future product candidates in the United States, if licensed for marketing, reimbursement, sale and distribution, whether alone or in collaboration with others;
- patient demand for our product candidates and any future product candidates, if licensed; and

- our ability to establish and enforce intellectual property rights in and to our product candidates or any future product candidates.

Many of the factors listed above are beyond our control and could cause us to experience significant delays or prevent us from obtaining regulatory approvals or commercialize our product candidates. Even if we are able to commercialize our product candidates, we may not achieve profitability soon after generating product sales, if ever. If we are unable to generate sufficient revenue through the sale of our product candidates or any future product candidates, we may be unable to continue operations without continued funding.

If we do achieve profitability, we may not be able to sustain or increase profitability on a quarterly or annual basis. Additionally, even if we succeed in commercializing one or more of our product candidates, we will continue to incur substantial research and development and other expenditures to research, develop and market additional product candidates. Our failure to become and remain profitable would decrease the value of our company and could impair our ability to raise capital, maintain our research and development efforts, expand our business or continue our operations. A decline in the value of our company also could cause you to lose all or part of your investment.

We may encounter unforeseen expenses, difficulties, complications, delays and other unknown factors that may adversely affect our business. The size of our future net losses will depend, in part, on the rate of future growth of our expenses and our ability to generate revenue. Our prior losses and expected future losses have had and will continue to have an adverse effect on our stockholders' equity and working capital.

Risks Related to Future Financial Condition

We will require substantial additional financing to develop and commercialize our product candidates and implement our operating plans. If we fail to obtain additional financing or cannot obtain financing at the levels we require due to unstable market and economic conditions or other reasons, we may be delayed in our plans or unable to complete the development and commercialization of our product candidates.

Our operations have consumed substantial amounts of cash since inception. We expect to continue to spend substantial amounts to continue the preclinical and clinical development of our product candidates, including our DesCAARTes™ trial, our initial *in vitro* studies and expected *in vivo* studies of MuSK-CAART, and our planned studies for DSG3/1-CAART as well as research and development, preclinical studies and clinical trials for FVIII-CAART and any future product candidates, to seek regulatory approvals for our product candidates, to enable commercial production of our products, if licensed, and to initiate and complete registration trials for multiple products. While we currently expect our existing cash and cash equivalents and investments to be sufficient to fund our operations through completion of Part A Dose Escalation of our DesCAARTes™ trial, we expect to require significant additional financing to complete this Phase 1 trial, and any future clinical trials of DSG3-CAART and our other product candidates. Further, if licensed, we will require significant additional amounts of cash to launch and commercialize our product candidates.

As of December 31, 2020, we had approximately \$108.7 million of cash and cash equivalents and investments. On October 29, 2019, we completed an initial public offering of our common stock by issuing 7,275,501 shares of our common stock (including 475,501 shares of our common stock pursuant to the underwriters' option to purchase additional shares that we issued in November 2019), at \$11.00 per share, for gross proceeds of \$80.0 million, or net proceeds of \$71.0 million. Based on our current operating plan, we believe that the net proceeds from our IPO together with our existing cash and cash equivalents and investments will be sufficient to fund our operations through at least the third quarter of 2022. However, we have based this estimate on assumptions that may prove to be wrong. Additionally, changing circumstances may cause us to consume capital significantly faster than we currently anticipate, and we may need to spend more money than currently expected because of circumstances beyond our control. We may require substantial additional capital for the further development and commercialization of our product candidates, including funding our internal manufacturing capabilities, and may need to raise additional funds sooner if we choose to expand more rapidly than we presently anticipate. Because the length of time and activities associated with development of our product candidates is highly uncertain, we are unable to estimate the actual funds we will require for development and any approved marketing and commercialization activities. Our future funding requirements, both near- and long-term, will depend on many factors, including, but not limited to:

- the initiation, progress, timing, costs and results of preclinical studies and clinical trials for our product candidates;
- the clinical development plans we establish for these product candidates;
- the number and characteristics of product candidates that we may develop or in-license;
- the terms of any collaboration agreements we may choose to conclude;
- the outcome, timing and cost of meeting regulatory requirements established by the FDA;
- the cost of filing, prosecuting, defending and enforcing our patent claims and other intellectual property rights;
- the cost of defending intellectual property disputes, including patent infringement actions brought by third parties against us or our product candidates;
- the effect of competing technological and market developments;
- the costs of establishing and maintaining a supply chain for the development and manufacture of our product candidates;
- the cost and timing of establishing, expanding and scaling manufacturing capabilities;
- the cost of maintaining the amount patient data for which we would be responsible following commercialization of one or more of our product candidates; and
- the cost of establishing sales, marketing and distribution capabilities for any product candidates for which we may receive regulatory approval in regions where we choose to commercialize our products on our own.

We cannot be certain that additional funding will be available on acceptable terms, or at all. As widely reported, global credit and financial markets have experienced extreme volatility and disruptions from the COVID-19 pandemic and related factors, including severely diminished liquidity and credit availability, declines in consumer confidence, declines in economic growth, increases in unemployment rates and uncertainty about economic stability. There can be no assurance that further deterioration in credit and financial markets and confidence in economic conditions will not occur. Until we are able to generate sufficient revenue to finance our cash requirements, we will need to finance our future cash needs through a combination of public or private equity offerings, debt financings, collaborations, strategic alliances, licensing arrangements and other marketing or distribution arrangements. If we are unable to raise additional capital in sufficient amounts or on terms acceptable to us, we may have to significantly delay, scale back or discontinue our research and development initiatives and clinical development plans. We could be required to seek collaborators for our product candidates at an earlier stage than otherwise would be desirable or on terms that are less favorable than might otherwise be available or relinquish or license on unfavorable terms our rights to our product candidates in markets where we otherwise would seek to pursue development or commercialization ourselves.

Future sales and issuances of our common stock or rights to purchase common stock, including pursuant to our equity incentive plans, could result in additional dilution of the percentage ownership of our stockholders and could cause our stock price to fall.

We expect that significant additional capital may be needed in the future to continue our planned operations, including conducting clinical trials, commercialization efforts, expanded research and development activities and costs associated with operating a public company. To raise capital, we may sell common stock, convertible securities or other equity securities in one or more transactions at prices and in a manner we determine from time to time. If we sell common stock, convertible securities or other equity securities, investors may be materially diluted by subsequent sales. Such sales may also result in material dilution to our existing stockholders, and new investors could gain rights, preferences and privileges senior to the holders of our common stock.

Pursuant to our equity incentive plans, our management is authorized to grant stock options to our employees, directors and consultants. Additionally, the number of shares of our common stock reserved for issuance under the 2019 Stock Option and Incentive Plan automatically increased on January 1, 2020 and will automatically increase each January 1 thereafter through and including January 1, 2029, by 4% of the total number of shares of our capital stock outstanding on December 31 of the preceding calendar year, or a lesser number of shares determined by our board of directors. Unless our board of directors elects not to increase the number of shares available for future grant each year, our stockholders may experience additional dilution, which could cause our stock price to fall.

Any of the above events could significantly harm our business, prospects, financial condition and results of operations and cause the price of our common stock to decline.

Risks Related to Our Intellectual Property

We rely heavily on certain in-licensed patent and other intellectual property rights in connection with our development of our product candidates and, if we fail to comply with our obligations under our existing and any future intellectual property licenses with third parties, we could lose license rights that are important to our business.

Our ability to develop and commercialize our product candidates is heavily dependent on in-licenses to patent rights and other intellectual property granted to us by third parties. For example, we depend heavily on our License Agreement with Penn and CHOP, which was entered into in 2018, amended and restated in July 2019, and further amended in May 2020, pursuant to which we obtained (a) a non-exclusive, non-sublicensable, worldwide research license to intellectual property controlled by Penn and CHOP to make, have made and use products in two subfields of use, (b) effective as of October 2018, an exclusive, worldwide, royalty-bearing license, with the right to sublicense, under certain of such intellectual property to make, use, sell, offer for sale and import products in the same two subfields of use, and (c) effective as of October 2018, a non-exclusive, worldwide, royalty-bearing license, with limited rights to sublicense, under certain of Penn's know-how, which know-how satisfies certain criteria and is listed on a mutually agreed to schedule, to make, have made, use, sell, offer for sale, import and have imported products in the same two subfields of use. We may enter into additional license agreements in the future. Our license agreement with Penn and CHOP imposes, and we expect that future license agreements will impose, various diligence, milestone payment, royalty, insurance and other obligations on us. If we fail to comply with our obligations under these licenses, our licensors, including Penn and CHOP, may have the right to terminate these license agreements, in which event we might not be able to market our product candidates. Termination of any of our license agreements or reduction or elimination of our licensed rights may also result in our having to negotiate new or reinstated licenses with less favorable terms.

We may need to obtain additional licenses from third parties to advance our research or allow commercialization of our product candidates, and we have done so from time to time. We may fail to obtain any of these licenses at a reasonable cost or on reasonable terms, if at all. In that event, we may be required to expend significant time and resources to develop or license replacement technology. If we are unable to do so, we may be unable to develop or commercialize the affected product candidates, which could harm our business significantly. We cannot provide any assurances that third-party patents do not exist which might be enforced against our current product candidates or future products, resulting in either an injunction prohibiting our sales, or, with respect to our sales, an obligation on our part to pay royalties and/or other forms of compensation to third parties.

Furthermore, in many cases, we may not have the right to control the preparation, filing and prosecution of patent applications, or to maintain the patents, covering technology that we in-license from third parties. For example, pursuant to our License Agreement with Penn and CHOP, Penn controls such activities for the patent rights licensed to us under such agreement. Therefore, although we provide input to Penn and CHOP on these activities, we cannot be certain that these patents will be prosecuted, maintained and enforced in a manner consistent with the best interests of our business. If our current or future licensors or collaboration partners fail to obtain, maintain or protect any patents or patent applications licensed to us, our rights to such patents and patent applications may be reduced or eliminated and our right to develop and commercialize any of our product candidates that are the subject of such licensed rights could be adversely affected.

Disputes may arise between us and our current and future licensors regarding intellectual property subject to a license agreement, including those related to:

- the scope of rights granted under the License Agreement and other interpretation-related issues;
- whether we have breached the License Agreement and whether any such breach is subject to a cure period;
- whether and the extent to which our technology and processes infringe on intellectual property of the licensor that is not subject to the licensing agreement;
- our right to sublicense patent and other rights to third parties under collaborative development relationships;
- our diligence obligations with respect to the use of the licensed technology in relation to our development and commercialization of our product candidates, and what activities satisfy those diligence obligations; and

- the ownership of inventions and know-how resulting from the joint creation or use of intellectual property by our licensors and us and our partners.

Furthermore, disputes may arise between us and our current or future licensors regarding the ownership of intellectual property developed by us, such that we may be required to assign or otherwise transfer such intellectual property to such licensor. In the event that the assigned or transferred intellectual property is covered by an existing license agreement with such licensor we may be required to make additional royalty or milestone payments, or both, to such licensor. If the assigned or transferred intellectual property is not covered by an existing license agreement, then we may be required to enter into an additional license agreement to advance our research or allow commercialization of our product candidates, which may not be available on commercially reasonable terms or at all.

If disputes over intellectual property that we have licensed, or license in the future, prevent or impair our ability to maintain our current licensing arrangements on acceptable terms, we may be unable to successfully develop and commercialize the affected product candidates.

If our efforts to protect the proprietary nature of the intellectual property related to our current and any future product candidates are not adequate, we may not be able to compete effectively in our market.

Our success depends in large part on our ability to obtain and maintain intellectual property protection in the United States and other countries with respect to our product candidates. If we do not adequately protect or enforce our intellectual property rights, competitors may be able to erode or negate any competitive advantage we may have, which could harm our business and ability to achieve profitability. To protect our proprietary position, we have in-licensed patent rights in the United States and abroad relating to the product candidates that are important to our business. The patent application and approval process is expensive, complex and time-consuming. Our licensors may not be able to file and prosecute all necessary or desirable patent applications at a reasonable cost or in a timely manner.

The patent position of biotechnology and pharmaceutical companies generally is highly uncertain. No consistent policy regarding the breadth of claims allowed in biotechnology and pharmaceutical patents has emerged to date in the United States or in many foreign jurisdictions. In addition, the determination of patent rights with respect to biological and pharmaceutical products commonly involves complex legal and factual questions, which has in recent years been the subject of much litigation. As a result, the issuance, scope, validity, enforceability and commercial value of our patent rights are highly uncertain. Pending patent applications cannot be enforced against third parties practicing the technology claimed in such applications unless and until a patent issues from such applications. Assuming the other requirements for patentability are met, currently, the first to file a patent application is generally entitled to the patent. However, prior to March 16, 2013, in the United States, the first to invent was entitled to the patent. Publications of discoveries in the scientific literature often lag behind the actual discoveries, and patent applications in the United States and other jurisdictions are typically not published until 18 months after filing, or in some cases not at all. Therefore, we cannot be certain that our licensors were the first to make the inventions claimed in the patents or pending patent applications we in-license, or that our licensors were the first to file for patent protection of such inventions.

Moreover, because the issuance of a patent is not conclusive as to its inventorship, scope, validity or enforceability, the patents or pending patent applications we in-license may be challenged in the courts or patent offices in the United States and abroad. For example, we may be subject to a third party preissuance submission of prior art to the U.S. Patent and Trademark Office, or USPTO, or become involved in post-grant review procedures, derivation proceedings, reexaminations, or *inter partes* review in the United States, or oppositions and other comparable proceedings in foreign jurisdictions, challenging our patent rights or the patent rights of others. An adverse determination in any such challenges may result in loss of exclusivity or in patent claims being narrowed, invalidated or held unenforceable, in whole or in part, which could limit our ability to stop others from using or commercializing similar or identical technology and products, or limit the duration of the patent protection of our technology and product candidates. In addition, given the amount of time required for the development, testing and regulatory review of new product candidates, patents protecting such candidates might expire before or shortly after such candidates are commercialized.

Changes in either the patent laws or interpretation of the patent laws in the United States and other countries may diminish the value of the patents we in-license or narrow the scope of our patent protection. In addition, the laws of foreign countries may not protect our rights to the same extent or in the same manner as the laws of the United States. For example, European patent law is more restrictive than U.S. patent law in connection with the patentability of methods of treatment of the human body.

We cannot predict whether the patent applications we in-license currently being pursued will issue as patents, whether the claims of any patent that has or may issue will provide us with a competitive advantage or prevent competitors from designing around the claims to develop competing technologies in a non-infringing manner, or whether we or our licensors will be able to successfully pursue patent applications in the future relating to our current product candidates or future products and product candidates. Moreover, the patent application and approval process is expensive and time-consuming. We or our licensors may not be able to file and prosecute all necessary or desirable patent applications at a reasonable cost or in a timely manner. Furthermore, we, or any future partners, collaborators, or licensees, may fail to identify patentable aspects of inventions made in the course of development and commercialization activities before it is too late to obtain patent protection on them. Therefore, we may miss potential opportunities to seek additional patent protection.

It is possible that defects of form in the preparation or filing of patent applications may exist, or may arise in the future, for example with respect to proper priority claims, inventorship, claim scope, or requests for patent term adjustments. If we fail to establish, maintain or protect such patents and other intellectual property rights, such rights may be reduced or eliminated. If there are material defects in the form, preparation, prosecution or enforcement of the patents or patent applications we in-license, such patents may be invalid and/or unenforceable, and such applications may never result in valid, enforceable patents. Any of these outcomes could impair our ability to prevent competition from third parties, which may have an adverse impact on our business.

Even if the patent applications we in-license issue as patents, they may not issue in a form that will provide us with any meaningful protection, prevent competitors from competing with us or otherwise provide us with any competitive advantage. Our competitors may be able to circumvent our patent rights by developing similar or alternative technologies or products in a non-infringing manner. Our competitors may also seek approval to market their own products similar to or otherwise competitive with our product candidates. Alternatively, our competitors may seek to market generic versions of any approved products by submitting abbreviated BLAs to the FDA during which process they may claim that patents licensed by us are invalid, unenforceable or not infringed. In these circumstances, we may need to defend or assert our intellectual property rights, or both, including by filing lawsuits alleging patent infringement. In any of these types of proceedings, a court or other agency with jurisdiction may find the patents we in-license invalid or unenforceable, or that our competitors are competing in a non-infringing manner. Thus, even if we have in-licensed valid and enforceable patents, these patents still may not provide protection against competing products or processes sufficient to achieve our business objectives. Any of the foregoing could have a material adverse effect on our competitive position, business, financial conditions, results of operations, and prospects.

In the future, we likely will need to expand our patent portfolio to pursue patent coverage for new product candidates that we wish to develop. The patent prosecution process is competitive, and other companies, some which may have greater resources than we do in this area, may also be pursuing intellectual property rights that we may consider necessary or attractive in order to develop and commercialize future product candidates.

We may not be able to protect our intellectual property rights throughout the world.

Filing, prosecuting, maintaining, defending and enforcing patents on our product candidates in all countries throughout the world would be prohibitively expensive, and our intellectual property rights in some countries outside the United States could be less extensive than those in the United States. The deadline to pursue protection in foreign jurisdictions for many of the patent families licensed under the License Agreement with Penn has not yet expired. Prior to applicable deadlines, we and Penn will need to decide where to pursue protection, and we will not have the opportunity to pursue protection unless we do so in applicable jurisdictions prior to the deadlines. Although our License Agreement grants us worldwide rights, there can be no assurance that we will obtain or maintain patent rights in or outside the United States under any future license agreements. In addition, the laws of some foreign countries do not protect intellectual property rights to the same extent as federal and state laws in the United States even in jurisdictions where we and our licensors pursue patent protection. Consequently, we and our licensors may

not be able to prevent third parties from practicing our inventions in all countries outside the United States, even in jurisdictions where we and our licensors pursue patent protection, or from selling or importing products made using our inventions in and into the United States or other jurisdictions. Competitors may use our technologies in jurisdictions where we and our licensors have not pursued and obtained patent protection to develop their own products and, further, may export otherwise infringing products to territories where we and our licensors have patent protection, but enforcement is not as strong as that in the United States. These products may compete with our product candidates and the patents we in-license or other intellectual property rights may not be effective or sufficient to prevent them from competing.

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

We or our licensors may be subject to claims challenging the inventorship or ownership of the patents and other intellectual property that we own or license.

We or our licensors may be subject to claims that former employees, collaborators or other third parties have an ownership interest in the patents and intellectual property that we in-license or that we may own or in-license in the future. While it is our policy to require our employees and contractors who may be involved in the development of intellectual property to execute agreements assigning such intellectual property to us, we may be unsuccessful in executing such an agreement with each party who in fact develops intellectual property that we regard as our own or such assignments may not be self-executing or may be breached. Our licensors may face similar obstacles. We or our licensors could be subject to ownership disputes arising, for example, from conflicting obligations of employees, consultants or others who are involved in developing our product candidates. For example, our scientific co-founders, Drs. Payne and Milone, are members of our scientific advisory board and are also employed by and subject to Penn's intellectual property policy. Litigation may be necessary to defend against any claims challenging inventorship or ownership. If we or our licensors fail in defending any such claims, we may have to pay monetary damages and may lose valuable intellectual property rights, such as exclusive ownership of, or right to use, intellectual property, which could adversely impact our business, results of operations and financial condition.

Some intellectual property which we have in-licensed was discovered through government funded programs and thus is subject to federal regulations such as "march-in" rights, certain reporting requirements, and a preference for U.S. industry. Compliance with such regulations may limit our exclusive rights and limit our ability to contract with non-U.S. manufacturers.

Certain of the intellectual property rights we have licensed, including rights licensed to us by Penn relating to our DSG3-CAART and DSG3/1-CAART product candidates, was generated through the use of U.S. government funding and may therefore be subject to certain federal laws and regulations. As a result, the U.S. government has certain rights to intellectual property embodied in our DSG3-CAART and DSG3/1-CAART product candidates and may have rights in future product candidates pursuant to the Bayh-Dole Act of 1980. These U.S. government rights in certain inventions developed under a government-funded program include a non-exclusive, non-transferable, irrevocable worldwide license to use inventions for any governmental purpose. In addition, the U.S. government has the right to require us to grant exclusive, partially exclusive, or non-exclusive licenses to any of these inventions to a third party if it determines that: (i) adequate steps have not been taken to commercialize the invention; (ii) government action is necessary to meet public health or safety needs; or (iii) government action is necessary to meet requirements for public use under federal regulations, also referred to as "march-in rights". The U.S. government also has the right to take title to these inventions if we, or the applicable licensor, such as Penn, fail to disclose the invention to the government and fail to file an application to register the intellectual property within

specified time limits. Intellectual property generated under a government funded program is also subject to certain reporting requirements, compliance with which may require us or the applicable licensor to expend substantial resources. In addition, the U.S. government requires that products embodying the subject invention or produced through the use of the subject invention be manufactured substantially in the United States. The manufacturing preference requirement can be waived if the owner of the intellectual property can show that reasonable but unsuccessful efforts have been made to grant licenses on similar terms to potential licensees that would be likely to manufacture substantially in the United States or that under the circumstances domestic manufacture is not commercially feasible. This preference for U.S. manufacturers may limit our ability to contract with non-U.S. product manufacturers for product candidates covered by such intellectual property.

We may become involved in lawsuits to protect or enforce our patent rights or other intellectual property rights, which could be expensive, time consuming and unsuccessful.

Competitors may infringe, misappropriate or otherwise violate patents, trademarks, copyrights or other intellectual property that we own or in-license. To counter infringement, misappropriation or other unauthorized use, we may be required to file claims, which can be expensive and time consuming and divert the time and attention of our management and scientific personnel. Any claims we assert against perceived violators could provoke these parties to assert counterclaims against us alleging that we infringe, misappropriate or otherwise violate their intellectual property, in addition to counterclaims asserting that the patents we in-license are invalid or unenforceable, or both. In any patent infringement proceeding, there is a risk that a court will decide that a patent we in-license is invalid or unenforceable, in whole or in part, and that we do not have the right to stop the other party from using the invention at issue. There is also a risk that, even if the validity of such patents is upheld, the court will construe the patent's claims narrowly or decide that we do not have the right to stop the other party from using the invention at issue on the grounds that the patent claims do not cover the invention. An adverse outcome in a litigation or proceeding involving the patents we in-license could limit our ability to assert the patent we in-license against those parties or other competitors and may curtail or preclude our ability to exclude third parties from making and selling similar or competitive products. Any of these occurrences could adversely affect our competitive business position, business prospects and financial condition.

Even if we establish infringement, misappropriation or another violation of our intellectual property rights, the court may decide not to grant an injunction against the offender and instead award only monetary damages, which may or may not be an adequate remedy. Furthermore, because of the substantial amount of discovery required in connection with intellectual property litigation, there is a risk that some of our confidential information could be compromised by disclosure during litigation. There could also be public announcements of the results of hearings, motions or other interim proceedings or developments. If securities analysts or investors perceive these results to be negative, it could have a material adverse effect on the price of our shares. Moreover, there can be no assurance that we will have sufficient financial or other resources to file and pursue such claims, which typically last for years before they are concluded. Even if we ultimately prevail in such claims, the monetary cost of such litigation and the diversion of the attention of our management and scientific personnel could outweigh any benefit we receive as a result of the proceedings. Any of the foregoing may have a material adverse effect on our business, financial condition, results of operations and prospects.

Changes in patent law in the United States and other jurisdictions could diminish the value of patents in general, thereby impairing our ability to protect our product candidates.

Changes in either the patent laws or the interpretation of the patent laws in the United States or other jurisdictions could increase the uncertainties and costs surrounding the prosecution of patent applications and the enforcement or defense of issued patents. On September 16, 2011, the Leahy-Smith America Invents Act, or the Leahy-Smith Act, was signed into law. When implemented, the Leahy-Smith Act included several significant changes to U.S. patent law that impacted how patent rights could be prosecuted, enforced and defended. In particular, the Leahy-Smith Act also included provisions that switched the United States from a "first-to-invent" system to a "first-to-file" system, allowed third-party submission of prior art to the USPTO during patent prosecution and set forth additional procedures to attack the validity of a patent by the USPTO administered post grant proceedings. Under a first-to-file system, assuming the other requirements for patentability are met, the first inventor to file a patent application generally will be entitled to the patent on an invention regardless of whether another inventor had made the invention earlier. The USPTO developed new regulations and procedures governing

the administration of the Leahy-Smith Act, and many of the substantive changes to patent law associated with the Leahy-Smith Act, and in particular, the first to file provisions, only became effective on March 16, 2013. It remains unclear what impact, if any, the Leahy-Smith Act will have on the operation of our business. However, the Leahy-Smith Act and its implementation could increase the uncertainties and costs surrounding the prosecution of the patent applications we in-license and the enforcement or defense of the issued patents we in-license, all of which could have a material adverse effect on our business.

The patent positions of companies engaged in the development and commercialization of biologics are particularly uncertain. For example, the Supreme Court of the United States issued its decision in *Association for Molecular Pathology v. Myriad Genetics, Inc.*, or *Myriad*, a case involving patent claims held by Myriad Genetics, Inc. relating to the breast cancer susceptibility genes BRCA1 and BRCA2. Myriad held that an isolated segment of naturally occurring DNA, such as the DNA constituting the BRCA1 and BRCA2 genes, is not patent-eligible subject matter, but that complementary DNA, which is an artificial construct that may be created from RNA transcripts of genes, may be patent-eligible. Thereafter, the USPTO issued a guidance memorandum instructing USPTO examiners on the ramifications of the Prometheus and Myriad rulings and apply the Myriad ruling to natural products and principles including all naturally occurring nucleic acids. Certain claims of our in-licensed patent applications contain, and any future patents we may obtain may contain, claims that relate to specific recombinant DNA sequences that are naturally occurring at least in part and, therefore, could be the subject of future challenges made by third parties.

We cannot assure you that our efforts to seek patent protection for one or more of our product candidates will not be negatively impacted by this Supreme Court decision, rulings in other cases or changes in guidance or procedures issued by the USPTO. We cannot fully predict what impact the Supreme Court's decisions in Myriad may have on the ability of life science companies to obtain or enforce patents relating to their products in the future. These decisions, the guidance issued by the USPTO and rulings in other cases or changes in USPTO guidance or procedures could have a material adverse effect on our existing patent rights and our ability to protect and enforce our intellectual property in the future.

If we are unable to protect the confidentiality of trade secrets, our business and competitive position would be harmed.

In addition to the protection afforded by patents, we rely on trade secret protection and confidentiality agreements to protect certain proprietary know-how that is not patentable or that we elect not to patent, processes for which patents are difficult to enforce, and any other elements of our product candidate discovery and development processes that involve proprietary know-how, information or technology that is not covered by patents. However, trade secrets can be difficult to protect and some courts inside and outside the United States are less willing or unwilling to protect trade secrets. We seek to protect our proprietary technology and processes, in part, by entering into confidentiality agreements with our employees, consultants, scientific advisors, and contractors. We cannot guarantee that we have entered into such agreements with each party that may have or has had access to our trade secrets or proprietary technology and processes. We also seek to preserve the integrity and confidentiality of our data and trade secrets by maintaining physical security of our premises and physical and electronic security of our information technology systems. While we have confidence in these individuals, organizations and systems, agreements or security measures may be breached, and we may not have adequate remedies for any breach.

In addition, our trade secrets may otherwise become known or be independently discovered by competitors. Competitors and other third parties could infringe, misappropriate or otherwise violate our intellectual property rights, design around our protected technology or develop their own competitive technologies that fall outside of our intellectual property rights. If any of our trade secrets were to be lawfully obtained or independently developed by a competitor or other third party, we would have no right to prevent them, or those to whom they communicate it, from using that technology or information to compete with us. If our trade secrets are not adequately protected or sufficient to provide an advantage over our competitors, our competitive position could be adversely affected, as could our business. Additionally, if the steps taken to maintain our trade secrets are deemed inadequate, we may have insufficient recourse against third parties for misappropriating our trade secrets.

Patent term may be inadequate to protect our competitive position on our product candidates for an adequate amount of time.

Given the amount of time required for the development, testing and regulatory review of new product candidates, patents protecting such candidates might expire before or shortly after such candidates are commercialized. In the United States, the Drug Price Competition and Patent Term Restoration Act of 1984 permits a patent term extension of up to five years beyond the normal expiration of the patent, which is limited to the approved indication (or any additional indications approved during the period of extension). However, a patent term extension cannot extend the remaining term of a patent beyond a total of 14 years from the date of the product's approval by the FDA, only one patent applicable to an approved drug is eligible for the extension, and only those claims covering the approved drug, a method for using it or a method for manufacturing it may be extended. In the future, if and when our product candidates receive FDA approval, we plan to apply for patent term extensions on patents covering those product candidates in any jurisdiction where these are available. However, the applicable authorities, including the FDA and the USPTO in the United States, and any equivalent regulatory authority in other countries, may not agree with our assessment of whether such extensions are available, and may refuse to grant extensions to the patents we in-license, or may grant more limited extensions than we request. Moreover, we may not receive an extension because of, for example, failing to apply within applicable deadlines, failing to apply prior to expiration of relevant patents or otherwise failing to satisfy applicable requirements. If this occurs, our competitors may be able to take advantage of our investment in development and clinical trials by referencing our clinical and preclinical data and launch their product earlier than might otherwise be the case.

We may be subject to claims asserting that our employees, consultants or advisors have wrongfully used or disclosed alleged trade secrets of their current or former employers or claims asserting ownership of what we regard as our own intellectual property.

Certain of our employees, consultants or advisors are currently, or were previously, employed at universities or other biotechnology or pharmaceutical companies, including our competitors or potential competitors. Although we try to ensure that our employees, consultants and advisors do not use the proprietary information or know-how of others in their work for us, we may be subject to claims that these individuals or we have used or disclosed intellectual property, including trade secrets or other proprietary information, of any such individual's current or former employer. Litigation may be necessary to defend against these claims. If we fail in defending any such claims, in addition to paying monetary damages, we may lose valuable intellectual property rights or personnel. Even if we are successful in defending against such claims, litigation could result in substantial costs and be a distraction to management. Our licensors may face similar risks, which could have an adverse impact on intellectual property that is licensed to us.

Intellectual property rights do not necessarily address all potential threats.

The degree of future protection afforded by our intellectual property rights is uncertain because intellectual property rights have limitations and may not adequately protect our business or permit us to maintain our competitive advantage. For example:

- others may be able to make products that are similar to our product candidates or utilize similar cell therapy technology but that are not covered by the claims of our current or future patent portfolio;
- we, or our current or future licensors or collaborators, might not have been the first to make the inventions covered by the issued patent or pending patent application that we license now or that we may license or own in the future;
- we, or our current or future licensors or collaborators, might not have been the first to file patent applications covering certain of our or their inventions;
- others may independently develop similar or alternative technologies or duplicate any of our technologies without infringing our licensed intellectual property rights;
- it is possible that our current or future licensed patent applications will not lead to issued patents;
- issued patents that we hold rights to may be held invalid or unenforceable, including as a result of legal challenges by our competitors or other third parties;

- our competitors or other third parties might conduct research and development activities in countries where we do not have patent rights and then use the information learned from such activities to develop competitive products for sale in our major commercial markets;
- we may not develop additional proprietary technologies that are patentable;
- the patents of others may harm our business;
- we may choose not to file a patent application in order to maintain certain trade secrets or know-how, and a third party may subsequently file a patent application covering such intellectual property; and
- third-party patents may issue with claims covering our activities; we may have infringement liability exposure arising from such patents.

Should any of these events occur, they could have a material adverse effect on our business, financial condition, results of operations and prospects.

We may become subject to claims that we are infringing certain third-party patents or other third-party intellectual property rights, any of which may prevent or delay our development and commercialization efforts and have a material adverse effect on our business.

Our commercial success depends in part on avoiding infringing, misappropriating and otherwise violating the patents and other intellectual property and proprietary rights of third parties. There is a substantial amount of litigation, both within and outside the United States, involving patent and other intellectual property rights in the biotechnology and pharmaceutical industries, including patent infringement lawsuits, and administrative proceedings such as interferences, *inter partes* review and post grant review proceedings before the USPTO and opposition proceedings before foreign patent offices. Numerous U.S. and foreign issued patents and pending patent applications, which are owned or controlled by third parties, including our competitors, exist in the fields in which we are pursuing product candidates. As the biotechnology and pharmaceutical industries expand and more patents are issued, the risk increases that our product candidates may be subject to claims of infringement of the patent rights of third parties.

Third parties may assert that we or our licensors are employing their proprietary technology without authorization. There may be third-party patents or patent applications with claims to materials, methods of manufacture or methods for treatment relating to our product candidates and, because patent applications can take many years to issue, there may be currently pending third party patent applications which may later result in issued patents, in each case that our product candidates, their manufacture or use may infringe or be alleged to infringe. We may fail to identify potentially relevant patents or patent applications, incorrectly conclude that a patent is invalid or does not cover our activities, or incorrectly conclude that a patent application is unlikely to issue in a form of relevance to our activities.

Parties making patent infringement claims against us may obtain injunctive or other equitable relief, which could effectively block our ability to further develop and commercialize one or more of our product candidates. Defense of these claims, including demonstrating non-infringement, invalidity or unenforceability of the respective patent rights in question, regardless of their merit, is time-consuming, would involve substantial litigation expense and would be a substantial diversion of employee resources from our business. For example, in order to successfully challenge the validity of any U.S. patent in federal court, we would need to overcome a presumption of validity. This is a high burden requiring us to present clear and convincing evidence as to the invalidity of any such U.S. patent claim, and we can provide no assurance that a court of competent jurisdiction would invalidate the claims of any such U.S. patent. We may not have sufficient resources to bring these actions to a successful conclusion. There could also be public announcements of the results of hearings, motions or other interim proceedings or developments. If securities analysts or investors perceive these results to be negative, it could have a material adverse effect on the price of our shares.

In the event that a holder of any such patents seeks to enforce its patent rights against us with respect to one or more of our product candidates, and our defenses against the infringement of such patent rights are unsuccessful, we may be precluded from commercializing our product candidates, even if approved, without first obtaining a license to some or all of these patents, which may not be available on commercially reasonable terms or at all. Moreover, we may be required to pay significant fees and royalties to secure a license to the applicable patents. Such a license may only be non-exclusive, in which case our ability to stop others from using or commercializing technology and products similar or identical to ours may be limited. Furthermore, we could be liable for damages to the holder of these patents, which may be significant and could include treble damages if we are found to have willfully infringed such patents. In the event that a challenge to these patents were to be unsuccessful or we were to become subject to litigation or unable to obtain a license on commercially reasonable terms with respect to these patents, it could harm our business, financial condition, results of operations and prospects.

We are aware of third-party issued U.S. patents relating to the lentiviral vectors which may be used in the manufacture or use of our product candidates. If these patent rights were enforced against us, we believe that we have defenses against any such action, including that these patents would not be infringed by our product candidates and/or that these patents are not valid. However, if these patents were enforced against us and defenses to such enforcement were unsuccessful, unless we obtain a license to these patents, which may not be available on commercially reasonable terms, or at all, we could be liable for damages and precluded from commercializing any product candidates that were ultimately held to infringe these patents, which could have a material adverse effect on our business, financial condition, results of operations and prospects.

Even in the absence of a finding of infringement, we may need or may choose to obtain licenses from third parties to advance our research or allow commercialization of our product candidates. We may fail to obtain any of these licenses at a reasonable cost or on reasonable terms, or at all. In that event, we would be unable to further develop and commercialize our product candidates. Claims that we have misappropriated the confidential information or trade secrets of third parties could have a similar negative impact on our business. Any of the foregoing could materially adversely affect our business, results of operations and financial condition.

Risks Related to Our Reliance on Third Parties

We are reliant on a research services agreement with Penn for our nonclinical research and development activities and current manufacturing activities.

If Penn and its affiliated entities were to fail to perform their obligations in accordance with the terms of the Services Agreement or terminate the Services Agreement with little notice, we may have difficulty continuing our normal business operations and our business prospects, financial condition and results of operations could be harmed. In addition, the termination of our relationship with Penn and the Services Agreement and any delay in appointing or finding a suitable replacement provider, if one exists, could make it difficult for us to operate our business for that period. Moreover, we will be reliant on Penn to assist us with any necessary technology transfer. Any delays or inadequacies in such technology transfer, or disputes regarding the scope of such technology transfer, could delay our operations, including our clinical trials, require us to expend additional resources and otherwise have an adverse effect on our business.

Additionally, over time we will need to transition from receiving the services that Penn currently provides to performing such services internally. The Services Agreement is scheduled to expire on the later of October 19, 2021 or completion of all research and development projects, and unless the Services Agreement is amended, Penn will not be obligated to provide any further services under the Services Agreement after that time. In addition, Penn has the right to terminate the Services Agreement in whole at any time with 90 days' notice and to terminate any research and development project being performed under the Services Agreement if the Penn service provider appointed to lead such project is unavailable and Penn is unavailable to find a replacement within 60 days for such service provider. Penn also has the right to terminate certain manufacturing services being performed under the Services Agreement with 180 days' written notice. From time to time, we may enter into further addenda to the Services Agreement that provide Penn with the right to terminate such addenda with limited notice periods. If we do not have adequate personnel and capabilities at the time that we assume responsibilities for such services, we may not be successful in effectively or efficiently transitioning these services from Penn, which could disrupt our business and have a material adverse effect on our financial condition and results of operations. Further, we will incur costs relating to establishing our own financial, administrative, information technology and other support functions as well as running and maintaining such functions on a going-forward basis. In addition, the process of establishing such functions may distract our management from focusing on business and strategic opportunities and could result in disruptions to our business. Even if we are able to successfully transition these services, they may be more expensive or less efficient than the services we are receiving from Penn during the transition period.

We will rely on third parties to conduct our clinical trials. If these third parties do not successfully carry out their contractual duties or meet expected deadlines, we may not be able to obtain regulatory approval of or commercialize our product candidates.

We depend and will continue to depend upon third parties, including independent investigators and collaborators, such as universities, medical institutions, CROs and strategic partners, to conduct our preclinical studies and clinical trials under agreements with us. Specifically, we depend on clinical trial sites to enroll patients and conduct the DesCAARTes™ trial in a timely and appropriate manner. If our clinical trial sites do not conduct the trial on the timeline we expect or otherwise fail to support the trial, our clinical trial results could be significantly delayed, thereby adversely impacting our leadership position in the CAAR T industry and our ability to progress additional product candidates. Further, although we intend to transition our manufacturing needs to a CMO and eventually secure our own clinical manufacturing facility, we must currently rely on Penn to manufacture supplies and process our product candidates. As we open additional clinical trial sites, we expect to have to negotiate budgets and contracts with CROs and study sites, which may result in delays to our development timelines and increased costs.

We will rely heavily on these third parties, including Penn, to conduct our preclinical studies and clinical trials, and as a result, will have limited control over the clinical investigators and limited visibility into their day-to-day activities, including with respect to their compliance with the approved clinical protocol. Nevertheless, we are responsible for ensuring that each of our trials is conducted in accordance with applicable protocol, legal, regulatory and scientific standards, and our reliance on third parties does not relieve us of our regulatory responsibilities. We and these third parties are required to comply with Good Clinical Practices, or GCPs, which are regulations and guidelines enforced by the FDA for product candidates in clinical development. Regulatory authorities enforce these GCPs through periodic inspections of trial sponsors, principal investigators and trial sites. If we or any of these third parties fail to comply with applicable GCP requirements, the clinical data generated in our clinical trials may be deemed unreliable and the FDA may require us to perform additional clinical trials before approving our marketing applications. We cannot provide assurance that, upon inspection, such regulatory authorities will not determine that some or all of our clinical trials do not fully comply with the GCP requirements. For any violations of laws and regulations during the conduct of our clinical trials, we could be subject to untitled and warning letters or enforcement action that may include civil penalties up to and including criminal prosecution. In addition, our clinical trials must be conducted with biologic product produced under cGMPs and will require a large number of test patients. We also are required to register ongoing clinical trials and post the results of completed clinical trials on a government-sponsored database within certain timeframes. Failure to do so can result in fines, adverse publicity and civil and criminal sanctions.

As widely reported, global credit and financial markets have experienced extreme volatility and disruptions from the COVID-19 pandemic and related factors, including severely diminished liquidity and credit availability, declines in consumer confidence, declines in economic growth, increases in unemployment rates and uncertainty about economic stability. In the event that one or more of our current or future service providers, manufacturers and other partners do not successfully carry out their contractual duties, meet expected deadlines, or conduct our clinical trials in accordance with regulatory requirements or our stated protocols, due to the economic downturn or for any other reasons, then we may not be able to obtain, or may be delayed in obtaining, marketing approvals for any product candidates we may develop and will not be able to, or may be delayed in our efforts to, successfully commercialize our medicines. Our failure or the failure of these third parties to comply with applicable regulatory requirements or our stated protocols could also subject us to enforcement action. Moreover, our business may be implicated if any of these third parties violates federal or state fraud and abuse or false claims laws and regulations or healthcare privacy and security laws.

Any third parties conducting our clinical trials will not be our employees and, except for remedies available to us under our agreements with such third parties, we cannot control whether or not they devote sufficient time and resources to our ongoing preclinical and clinical programs. These third parties may also have relationships with other commercial entities, including our competitors, for whom they may also be conducting clinical studies or other drug development activities, which could affect their performance on our behalf. If these third parties do not successfully carry out their contractual duties or obligations or meet expected deadlines, if they need to be replaced or if the quality or accuracy of the clinical data they obtain is compromised due to the failure to adhere to our clinical protocols or regulatory requirements or for other reasons, our clinical trials may be extended, delayed or terminated and we may not be able to complete development of, obtain regulatory approval of or successfully commercialize our product candidates. As a result, our financial results and the commercial prospects for our product candidates would be harmed, our costs could increase and our ability to generate revenue could be delayed.

If any of our relationships with trial sites, or any CRO that we may use in the future, terminates, we may not be able to enter into arrangements with alternative trial sites or CROs or do so on commercially reasonable terms. Switching or adding third parties to conduct our clinical trials involves substantial cost and requires extensive management time and focus. In addition, there is often a natural transition period when a new third party commences work. As a result, delays may occur, which can materially impact our ability to meet our desired clinical development timelines. Though we carefully manage our relationships with our CROs, there can be no assurance that we will not encounter similar challenges or delays in the future or that these delays or challenges will not have a material adverse impact on our business, financial condition and prospects.

We also expect to rely on other third parties to store and distribute drug supplies for our clinical trials. Any performance failure on the part of our distributors could delay clinical development or marketing approval of any

product candidates we may develop or commercialization of our medicines, producing additional losses and depriving us of potential product revenue.

We intend to rely on third parties to manufacture our clinical product supplies, and we may have to rely on third parties to produce and process our product candidates, if licensed.

Although we may eventually secure our own clinical manufacturing facility for any late phase clinical development that we undertake, we currently rely on Penn to supply raw materials and other important components that are used to manufacture our product candidates and intend in the future to rely on CMOs. In the case of any manufacturing performed for us by Penn, the services performed for us risk being delayed because of the competing priorities that Penn has for utilization of its manufacturing resources and any capacity issues that thereby arise.

We do not yet have sufficient information to reliably estimate the cost of the manufacturing and processing of our product candidates in clinical quantity or commercial quantity, and the actual cost to manufacture and process our product candidates could ultimately materially and adversely affect the commercial viability of our product candidates. As a result, we may never be able to develop a commercially viable product.

In addition, our anticipated reliance on a limited number of third-party manufacturers exposes us to the following risks:

- We may be unable to identify manufacturers on acceptable terms or at all because the number of potential manufacturers is limited and the FDA may have questions regarding any replacement contractor. This may require new testing and regulatory interactions. In addition, a new manufacturer would have to be educated in, or develop substantially equivalent processes for, production of our products after receipt of FDA questions, if any.
- Our third-party manufacturers might be unable to timely formulate and manufacture our product or produce the quantity and quality required to meet our clinical and commercial needs, if any.
- Contract manufacturers may not be able to execute our manufacturing procedures appropriately.
- Any contract manufacturers that we engage may not perform as agreed or may not remain in the contract manufacturing business for the time required to supply our clinical trials or to successfully produce, store and distribute our product candidates.
- Manufacturers are subject to ongoing periodic unannounced inspection by the FDA and corresponding state agencies to ensure strict compliance with cGMP and other government regulations. We do not have control over third-party manufacturers' compliance with these regulations and standards.
- We may not own, or may have to share, the intellectual property rights to any improvements made by our third-party manufacturers in the manufacturing process for our product candidates.
- Our third-party manufacturers could breach or terminate their agreement with us.

Furthermore, all of our contract manufacturers are engaged with other companies to supply and/or manufacture materials or products for such companies, which exposes our manufacturers to regulatory risks related to the production of such materials and products. As a result, failure to meet the regulatory requirements for the production of those materials and products may affect the regulatory clearance of our contract manufacturers' facilities generally. If the FDA does not approve these facilities for the manufacture of our product candidates or if any agency withdraws its approval in the future, we may need to find alternative manufacturing facilities, which would negatively impact our ability to develop, obtain regulatory approval for or market our product candidates, if licensed.

Our contract manufacturers would also be subject to the same risks we face in developing our own manufacturing capabilities, as described above. Each of these risks could delay our clinical trials, the approval, if any of our product candidates by the FDA or the commercialization of our product candidates or result in higher costs or deprive us of potential product revenue. In addition, we will rely on third parties to perform release tests on our product candidates prior to delivery to patients. If these tests are not appropriately done and test data are not reliable, patients could be put at risk of serious harm.

For more information, see “Risk Factors—Risks Related to Manufacturing and Supply”.

We may form or seek strategic alliances or enter into additional licensing arrangements in the future, and we may not realize the benefits of such alliances or licensing arrangements.

We may form or seek strategic alliances, create joint ventures or collaborations or enter into additional licensing arrangements with third parties that we believe will complement or augment our development and commercialization efforts with respect to our product candidates and any future product candidates that we may develop. Any of these relationships may require us to incur non-recurring and other charges, increase our near and long-term expenditures, issue securities that dilute our existing stockholders or disrupt our management and business. In addition, we face significant competition in seeking appropriate strategic partners and the negotiation process is time-consuming and complex. Moreover, we may not be successful in our efforts to establish a strategic partnership or other alternative arrangements for our product candidates because they may be deemed to be at too early of a stage of development for collaborative effort and third parties may not view our product candidates as having the requisite potential to demonstrate safety, potency and purity. Any delays in entering into new strategic partnership agreements related to our product candidates could delay the development and commercialization of our product candidates in certain geographies for certain indications, which would harm our business prospects, financial condition and results of operations.

If we license products or businesses, we may not be able to realize the benefit of such transactions if we are unable to successfully integrate them with our existing operations and company culture. For instance, our License Agreement with Penn and CHOP requires significant research and development commitments that may not result in the development and commercialization of our product candidates, including DSG3-CAART and our other product candidates. We cannot be certain that, following a strategic transaction or license, we will achieve the results, revenue or specific net income that justifies such transaction.

We may not realize the benefits of acquired assets or other strategic transactions, including any transactions whereby we acquire or license manufacturing and other advanced technologies.

In August 2018, we entered into a License Agreement with Penn and CHOP which was amended and restated in July 2019, and further amended in May 2020, or the License Agreement, pursuant to which we were granted licenses to certain patent rights for the research and development of products, as well as an exclusive license under those same patent rights to make, use, sell and import such products, in the autoimmune disease and alloimmune response subfields, in each case, for the treatment of humans.

We actively evaluate various strategic transactions on an ongoing basis. We may acquire other businesses, products or technologies as well as pursue joint ventures or investments in complementary businesses. The success of our strategic transactions, including the License Agreement, and any future strategic transactions depends on the risks and uncertainties involved including:

- unanticipated liabilities related to acquired companies or joint ventures;
- 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;
- disruption in our relationships with collaborators or suppliers as a result of such a transaction; and
- possible write-offs or impairment charges relating to acquired businesses or joint ventures.

If any of these risks or uncertainties occur, we may not realize the anticipated benefit of any acquisition or strategic transaction. Additionally, foreign acquisitions and joint ventures are subject to additional risks, including those related to integration of operations across different cultures and languages, currency risks, potentially adverse

tax consequences of overseas operations and the particular economic, political and regulatory risks associated with specific countries.

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.

Risks Related to Manufacturing and Supply

We currently rely upon Penn for our manufacturing needs, and we intend to rely on other third parties for our future manufacturing needs prior to establishing our own manufacturing facility.

We are currently reliant upon Penn for our cell product manufacturing for our lead product candidate, DSG3-CAART. In parallel with initiating our first clinical trial, we have entered into an agreement with a CMO to help secure the manufacturing supply chain for future product candidates. We will need to develop relationships with suppliers, increase the scale of production and demonstrate comparability of the material produced at these facilities to the material that was previously produced. Transferring manufacturing processes and know-how is complex and involves review and incorporation of both documented and undocumented processes that may have evolved over time.

In addition, transferring production to different facilities may require utilization of new or different processes to meet the specific requirements of a given facility. We would expect additional comparability work will also need to be conducted to support the transfer of certain manufacturing processes and process improvements. We cannot be certain that all relevant know-how and data has been adequately incorporated into the manufacturing process until the completion of studies (and the related evaluations) intended to demonstrate the comparability of material previously produced with that generated by any CMO that we engage for our manufacturing needs. If we are not able to successfully transfer and produce comparable product candidates, our ability to further develop and manufacture our product candidates may be negatively impacted.

We plan to eventually establish our own manufacturing facility. While the addition of our own manufacturing facility would provide us with future flexibility within our manufacturing network, we still may need to identify additional CMOs for continued production of supply for some or all of our product candidates. Given the nature of our manufacturing processes, the number of CMOs who possess the requisite skill and capability to manufacture our CAAR T cell immunotherapy product candidates is limited.

Further, we may not be able to achieve clinical manufacturing and cell processing through Penn on a timely basis, on our own or at any future CMO. While our current manufacturing process is based off the validated process developed at Penn for CD19 CAR T, or CART19, we have limited experience as an organization in managing the CAAR T engineering process. Finally, because clinical manufacturing and cell processing is highly complex and patient donor material is inherently variable, we cannot be sure that the manufacturing processes employed by Penn, any CMO that we engage in the future, or by us at a manufacturing facility that we establish will consistently result in T cells that will be safe and effective.

Our product candidates are uniquely manufactured. If we, Penn or any of our third-party manufacturers encounter difficulties in manufacturing our product candidates, our ability to provide supply of our product candidates for clinical trials or, if licensed, for commercial sale, could be delayed or stopped, or we may be unable to maintain a commercially viable cost structure.

The manufacturing process used to produce our product candidates is complex and novel, and it has not yet been validated for commercial production. Among the complex processes used in the manufacture of our product candidates is the manufacture of the lentiviral delivery vector used to deliver the applicable CAAR gene into the T cells. For example, the manufacture of our product candidates includes harvesting white blood cells from each patient, stimulating certain T cells from the white blood cells and thereby causing them to activate and proliferate, combining patient T cells with our lentiviral delivery vector through a process known as transduction, expanding the transduced T cells to obtain the desired dose, and ultimately infusing the modified T cells back into the patient's body. Notably, the manufacture of both DSG3/1-CAART and FVIII-CAART may be more challenging or require new gene delivery technology due to the need to deliver large transgenes for these programs, and vector delivery systems have size limitations. Because of these complexities, the cost to manufacture our product candidates is higher than traditional small molecule chemical compounds and monoclonal antibodies, and the manufacturing process is less reliable and is more difficult to reproduce. Furthermore, our manufacturing process development and scale-up is at an early stage. The actual cost to manufacture and process our product candidates could be greater than we expect and could materially and adversely affect the commercial viability of our product candidates.

Our manufacturing process may be susceptible to technical and logistics delays or failures due to the fact that each patient is an independent manufacturing lot, and also due to unique supply chain requirements. These include the collection of white blood cells from patients' blood, variability in the quality of white blood cells collected from patients' blood, cryopreservation of the white blood cells collected, packaging and shipment of frozen white blood cells to the manufacturing site in order to enable multi-site studies, procurement of lentiviral vectors that meet potency and purity requirements and shipment to the product candidate manufacturing site, shipment of the final product to clinical centers, manufacturing issues associated with interruptions in the manufacturing process, scheduling constraints for cell manufacturing slots, process contamination, equipment or reagent failure, improper installation or operation of equipment, vendor or operator error, and inconsistency in cell growth. Even minor deviations from normal manufacturing processes could result in reduced production yields, lot failures, product defects, product recalls, product liability claims and other supply disruptions. If microbial, viral, or other contaminations are discovered in our product candidates or in the manufacturing facilities in which our product candidates are made, production at such manufacturing facilities may be interrupted for an extended period of time to investigate and remedy the contamination. Further, as product candidates are developed through preclinical studies to late-stage clinical trials toward approval and commercialization, it is common that various aspects of the development program, such as manufacturing methods, are altered along the way in an effort to optimize processes and results. Such changes may result in the need to enroll additional patients or to conduct additional clinical studies to evaluate the impact of changes on product safety and efficacy. Penn has informed us that it will be unable provide clinical supply for any late-phase clinical trials of our product candidates that we may conduct. Therefore, we will need to enter into new agreements with CMOs to produce clinical supply of our product candidates for late-phase clinical trials. We cannot guarantee that we will be able to enter into such agreements on commercially acceptable terms, if at all. We will need to transfer the technology to manufacture our product candidates to these CMOs, and these CMOs may decide or be required to adopt different manufacturing protocols or processes, which may require us to amend any ongoing or proposed clinical trial protocols or perform additional preclinical studies to demonstrate the comparability of any such new manufacturing protocols or processes. We cannot provide any assurance that Penn will provide adequate support to efficiently and effectively transfer the technology or that disputes will not arise between us and Penn regarding the necessary scope of technology transfer, that the technology transfer will be successful, or that any CMO will be successful in producing our product candidates in sufficient quantities or of acceptable quality, if at all. Such changes carry the risk that they will not achieve these intended objectives, and any of these changes could cause our product candidates to perform differently and affect the results of ongoing and planned clinical trials or other future clinical trials.

Although we continue to optimize our manufacturing process for our product candidates, doing so is a difficult and uncertain task, and there are risks associated with scaling to the level required for advanced clinical trials or commercialization, including, among others, cost overruns, potential problems with process scale-up, process reproducibility, stability issues, lot consistency and timely availability of reagents and/or raw materials. We ultimately may not be successful in transferring our production system from our contract manufacturer to any manufacturing facilities we may establish ourselves, or our contract manufacturer may not have the necessary capabilities to complete the implementation and development process. If we are unable to adequately validate or scale-up the manufacturing process for our product candidates with our current manufacturer, we will need to transfer to another manufacturer and complete the manufacturing validation process, which can be lengthy. If we are able to adequately validate and scale-up the manufacturing process for our product candidates with a contract manufacturer, we will still need to negotiate with such contract manufacturer an agreement for commercial supply and it is not certain we will be able to come to agreement on terms acceptable to us. As a result, we may ultimately be unable to reduce the cost of goods for our product candidates to levels that will allow for an attractive return on investment if and when those product candidates are commercialized.

In addition, many of the components which are required to support our cell manufacturing process, such as equipment, media, growth factors and disposables, are highly specialized and it is possible that the supply chain for these materials may be interrupted. If we are unable to promptly remedy such interruption, then there may be delays to our clinical development efforts.

The manufacturing process for any products that we may develop is subject to the FDA approval process, and we will need to contract with manufacturers who can meet all applicable FDA requirements on an ongoing basis.

The manufacturing process for any products that we may develop is subject to the FDA approval process, and we will need to contract with manufacturers who can meet all applicable FDA requirements on an ongoing basis. If we or our CMOs are unable to reliably produce products to specifications acceptable to the FDA, we may not obtain or maintain the approvals we need to commercialize such products. Even if we obtain regulatory approval for any of our product candidates, there is no assurance that either we or our CMOs will be able to manufacture the approved product in accordance with requirements from the FDA, to produce it in sufficient quantities to meet the requirements for the potential launch of the product, or to meet potential future demand. Any of these challenges could delay completion of clinical trials, require bridging clinical trials or the repetition of one or more clinical trials, increase clinical trial costs, result in sanctions being imposed on us, including clinical holds, fines, injunctions, civil penalties, delays, suspension or withdrawal of approvals, license revocation, suspension of production or recalls of the product candidates or marketed biologics, operating restriction and criminal prosecutions, delay approval of our product candidates, impair commercialization efforts, increase our cost of goods, and have an adverse effect on our business, financial condition, results of operations and growth prospects. Our future success depends on our ability to manufacture our products, if licensed, on a timely basis with acceptable manufacturing costs, while at the same time maintaining good quality control and complying with applicable regulatory requirements, and an inability to do so could have a material adverse effect on our business, financial condition, and results of operations. In addition, we could incur higher manufacturing costs if manufacturing processes or standards change, and we could need to replace, modify, design, or build and install equipment, all of which would require additional capital expenditures. Specifically, because our product candidates may have a higher cost of goods than conventional therapies, the risk that coverage and reimbursement rates may be inadequate for us to achieve profitability may be greater.

The manufacture of viral vectors is complex and variable, and there are a limited number of manufacturers able to supply us with viral vectors.

Our DSG3-CAART and MuSK-CAART product candidates utilize a lentiviral delivery vector and some or all of our other product candidates may require a lentiviral delivery vector, a key drug substance that delivers the CAAR to the target T cells. We do not have the capability to manufacture lentiviral vector and plan to obtain the vector we require from third parties. The manufacturing process for lentiviral vector is variable and still evolving. It is not uncommon for manufacturing runs to fail, whether due to contamination, supplier error, or equipment failure, or to be delayed. To the extent our product candidates use a lentiviral delivery vector, a lack of vector supply will cause us to be unable to manufacture our CAAR T cells as well as a delay in patient enrollment, which may have a negative impact on our ability to successfully develop our product candidates.

Further, there are a limited number of manufacturers capable of producing lentiviral vectors. It can be challenging to secure a relationship with any of these manufacturers, and the manufacturing and release process can take a significant amount of time. We have secured a supply of lentiviral vector from CHOP sufficient for a portion of the patients we plan to enroll in our DesCAARTes™ trial. We have also reserved additional vector manufacturing capacity at Penn and CHOP and we have engaged other CMOs to evaluate their potential capabilities and capacity for additional supply. There is no assurance that we will be able to secure adequate and timely supply of lentiviral vector. Moreover, we cannot be certain that our CAAR T cell product candidates produced with lentiviral vector from different manufacturers will be comparable or that results of clinical trials will be consistent if conducted with lentiviral vector from different manufacturers.

Vector production also requires the production of high-quality DNA plasmids, for which there is also a limited number of suppliers. Although we have established relationships with multiple suppliers for lentiviral vector and plasmids, we do not yet have our own clinical-scale manufacturing facility established, and are therefore highly dependent on the ability of these suppliers to manufacture necessary materials and to deliver these materials to us on a timely and reliable basis.

If we are to operate our own manufacturing facility, significant resources will be required and we may fail to successfully operate our facility, which could adversely affect our clinical trials and the commercial viability of our product candidates.

If we establish our own manufacturing facility, our operations will be subject to review and oversight by the FDA and the FDA could object to our use of our manufacturing facility. We must first receive approval from the FDA prior to licensure to manufacture our product candidates, which we may never obtain. Even if licensed, we would be subject to ongoing periodic unannounced inspection by the FDA and corresponding state agencies to ensure strict compliance with cGMPs and other government regulations. Our license to manufacture product candidates will be subject to continued regulatory review.

Our cost of goods development is at an early stage. The actual cost to manufacture and process our product candidates could be greater than we expect and could materially and adversely affect the commercial viability of our product candidates.

The manufacture of biopharmaceutical products is complex and requires significant expertise, and can be impacted by resource constraints, labor disputes and workforce limitations.

The manufacture of biopharmaceutical products is complex and requires significant expertise, including the development of advanced manufacturing techniques and process controls. Manufacturers of cell therapy products often encounter difficulties in production, particularly in scaling out and validating initial production and ensuring the absence of contamination. These problems include difficulties with production costs and yields, quality control, including stability of the product, quality assurance testing, operator error, shortages of qualified personnel, as well as compliance with strictly enforced federal, state and foreign regulations. Furthermore, if contaminants are discovered in our supply of product candidates or in the manufacturing facilities upon which we currently or will rely, such manufacturing facilities may need to be closed for an extended period of time to investigate and remedy the contamination. We cannot assure you that any stability or other issues relating to the manufacture of our product candidates, whether by Penn, by a third-party CMO, or at any manufacturing facility that we may establish, will not occur in the future.

Penn, third-party CMOs that we engage or we may fail to manage the logistics of storing and shipping our product candidates. Storage failures and shipment delays and problems caused by us, our vendors or other factors not in our control, such as weather, could result in loss of usable product or prevent or delay the delivery of product candidates to patients.

Penn, third-party CMOs that we engage, or we may also experience manufacturing difficulties due to resource constraints, labor disputes or workforce limitations arising from the expanding need for manufacturing in the cell therapy field and the limited number of training programs for technical staff. If we were to encounter any of these difficulties, our ability to provide our product candidates to patients would be jeopardized.

We are dependent upon the availability of specialty raw materials and the production capabilities of small manufacturers to source the components of our product candidates.

Our product candidates require many specialty raw materials, some of which are manufactured by small companies with limited resources and experience to support a commercial product, and the suppliers may not be able to deliver raw materials to our specifications. In addition, those suppliers generally do not have the capacity to support commercial products manufactured under cGMP by biopharmaceutical firms. The suppliers may be ill-equipped to support our needs, especially in non-routine circumstances like an FDA inspection or medical crisis, such as widespread contamination. We also do not have contracts with many of these suppliers, and we may not be able to contract with them on acceptable terms or at all. Accordingly, we may experience delays in receiving key raw materials to support clinical or commercial manufacturing.

In addition, some raw materials are currently available from a single supplier, or a small number of suppliers. We cannot be sure that these suppliers will remain in business or that they will not be purchased by one of our competitors or another company that is not interested in continuing to produce these materials for our intended purpose. In addition, the lead time needed to establish a relationship with a new supplier can be lengthy, and we may experience delays in meeting demand in the event we must switch to a new supplier. The time and effort to qualify a new supplier could result in additional costs, diversion of resources or reduced manufacturing yields, any of which would negatively impact our operating results. Further, we may be unable to enter into agreements with a new supplier on commercially reasonable terms, which could have a material adverse impact on our business. We are also unable to predict how changing global economic conditions or global health concerns such as the COVID-19 pandemic will affect our third-party suppliers and manufacturers. For example, two vaccines for COVID-19 were granted Emergency Use Authorization by the FDA in late 2020, and more are likely to be authorized in the coming months. The resultant demand for vaccines and potential for manufacturing facilities and materials to be commandeered under the Defense Production Act of 1950, or equivalent foreign legislation, may make it more difficult to obtain materials or manufacturing slots for the products needed for our clinical trials, which could lead to delays in these trials. Any negative impact of such matters on our third-party suppliers and manufacturers may also have an adverse impact on our results of operations or financial condition.

We may encounter difficulties in production, particularly with respect to process development or scaling up of our manufacturing capabilities. If we encounter such difficulties, our ability to provide supply of our CAAR T cells for clinical trials or for commercial purposes could be delayed or stopped.

Establishing clinical and commercial manufacturing and supply is a difficult and uncertain task, and there are risks associated with scaling to the level required for advanced clinical trials or commercialization, including, among others, increased costs, potential problems with process scale-out, process reproducibility, stability issues, lot consistency, and timely availability of reagents or raw materials. For example, we may find it difficult to establish a manufacturing process that is consistent. If this occurs, we may need to complete more than one manufacturing run for each treated patient, which would impact the availability of adequate coverage and reimbursement from third-party payors. Competitors that have developed CAR T cell therapies have had difficulty reliably producing engineered T cell therapies in the commercial setting. If we experience similar challenges manufacturing product candidates to approved specifications, this may limit our product candidates' utilization and our ability to receive payment for these product candidates once licensed. Alternatively, these challenges may require changes to our manufacturing processes, which could require us to perform additional clinical studies, incurring significant expense. We may ultimately be unable to reduce the expenses associated with our product candidates to levels that will allow us to achieve a profitable return on investment.

If we or our third-party suppliers use hazardous, non-hazardous, biological or other materials in a manner that causes injury or violates applicable law, we may be liable for damages.

Our research and development activities involve the controlled use of potentially hazardous substances, including chemical and biological materials. We and our suppliers are subject to federal, state and local laws and regulations in the United States governing the use, manufacture, storage, handling and disposal of medical and hazardous materials. Although we believe that we and our suppliers' procedures for using, handling, storing and disposing of these materials comply with legally prescribed standards, we and our suppliers cannot completely eliminate the risk of contamination or injury resulting from medical or hazardous materials. As a result of any such contamination or injury, we may incur liability or local, city, state or federal authorities may curtail the use of these materials and interrupt our business operations. In the event of an accident, we could be held liable for damages or penalized with fines, and the liability could exceed our resources. We do not have any insurance for liabilities arising from medical or hazardous materials. Compliance with applicable environmental laws and regulations is expensive, and current or future environmental regulations may impair our research, development and production efforts, which could harm our business, prospects, financial condition or results of operations.

Changes in product candidate manufacturing or formulation may result in additional costs or delay, which could adversely affect our business, results of operations and financial condition.

As product candidates are developed through preclinical studies to later-stage clinical trials towards approval and commercialization, it is common that various aspects of the development program, such as manufacturing methods or formulation, are altered along the way in an effort to optimize processes and results. Any of these changes could cause our product candidates to perform differently and affect the results of ongoing and planned clinical trials or other future clinical trials conducted with the altered materials or with materials made with the altered methods. Such changes may also require additional testing, or notification to, or approval by the FDA or other regulatory authorities. This could delay completion of clinical trials, require the conduct of bridging clinical trials or studies, require the repetition of one or more clinical trials, increase clinical trial costs, delay approval of our product candidates and/or jeopardize our ability to commence product sales and generate revenue.

Risks Related to Government Regulation

The FDA regulatory approval process is lengthy and time-consuming, and we may experience significant delays in the clinical development and regulatory approval of our product candidates.

The research, testing, manufacturing, labeling, approval, selling, import, export, marketing and distribution of drug products, including biologics, are subject to extensive regulation by the FDA and other regulatory authorities in the United States. We are not permitted to market any biological drug product in the United States until we receive approval of a Biologics License Application, or BLA, from the FDA. We have not previously submitted a BLA to the FDA, or similar licensure filings to comparable foreign authorities. A BLA must include extensive preclinical and clinical data and supporting information to establish the product candidate's safety, potency and purity for each desired indication. The BLA must also include significant information regarding the chemistry, manufacturing and controls for the product, including with respect to chain of identity and chain of custody of the product.

We expect the novel nature of our product candidates to create further challenges in obtaining regulatory approval. For example, the FDA has not previously reviewed regulatory applications for the commercial development of CAAR T cells for treatment of pemphigus, and there is no therapy currently approved by the FDA for the treatment of mPV. Because of this, we have little guidance as to which endpoints will be accepted, how many clinical trials we may expect to conduct, and whether open-label clinical trials will be deemed acceptable, among other things. We may also request regulatory approval of future CAAR T cell-based product candidates by target, regardless of disease type or origin, which the FDA may have difficulty accepting if our clinical trials only involved diseases of certain origins. The FDA may also require a panel of experts, referred to as an Advisory Committee, to deliberate on the adequacy of the safety, potency and purity data to support licensure. The opinion of the Advisory Committee, although not binding, may have a significant impact on our ability to obtain licensure of the product candidates based on the completed clinical trials, as the FDA often adheres to the Advisory Committee's recommendations. Further, given the rapidly evolving landscape of cell therapy, we could encounter a significant change in the regulatory environment for our product candidates once we have already begun one or more lengthy and expensive clinical trials for our product candidates. Accordingly, the regulatory approval pathway for our product candidates may be uncertain, complex, expensive and lengthy, and approval may not be obtained.

We may also experience delays in completing ongoing and planned clinical trials for a variety of reasons, including delays related to:

- obtaining regulatory authorization to begin a trial, if applicable;
- the availability of financial resources to commence and complete the planned trials;
- reaching agreement on acceptable terms with prospective CROs and clinical trial sites, the terms of which can be subject to extensive negotiation and may vary significantly among different CROs and trial sites;
- obtaining approval at each clinical trial site by an independent IRB;
- recruiting suitable patients to participate in a trial;
- having patients complete a trial, including having patients enrolled in clinical trials dropping out of the trial before the product candidate is manufactured and returned to the site, or return for post-treatment follow-up;
- clinical trial sites deviating from trial protocol or dropping out of a trial;
- addressing any patient safety concerns that arise during a trial;
- adding new clinical trial sites; or
- manufacturing sufficient quantities of qualified materials under cGMPs and applying them on a patient by patient basis for use in clinical trials.

We could also encounter delays if physicians encounter unresolved ethical issues associated with enrolling patients in clinical trials of our product candidates in lieu of prescribing existing treatments that have established safety and efficacy profiles. Further, a clinical trial may be suspended or terminated by us, the IRBs for the institutions in which such trials are being conducted or by the FDA or other regulatory authorities due to a number of factors, including failure to conduct the clinical trial in accordance with regulatory requirements or our clinical protocols, inspection of the clinical trial operations or trial site by the FDA or other regulatory authorities resulting in the imposition of a clinical hold, unforeseen safety issues or adverse side effects, failure to demonstrate a benefit from using a product candidate, changes in governmental regulations or administrative actions, lack of adequate funding to continue the clinical trial, or based on a recommendation by the DSMB. If we experience termination of, or delays in the completion of, any future clinical trial of our product candidates, the commercial prospects for our product candidates will be harmed, and our ability to generate product revenue will be delayed. In addition, any delays in completing our clinical trials will increase our costs, slow down our product development and approval process and jeopardize our ability to commence product sales and generate revenue. Many of the factors that cause, or lead to, a delay in the commencement or completion of clinical trials may ultimately lead to the denial of regulatory approval of our product candidates.

We expect the product candidates we develop will be regulated as biological products, or biologics, and therefore they may be subject to competition.

The Biologics Price Competition and Innovation Act of 2009, or BPCIA, was enacted as part of the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act, or collectively the ACA, to establish an abbreviated pathway for the approval of biosimilar and interchangeable biological products. The regulatory pathway establishes legal authority for the FDA to review and approve biosimilar biologics, including the possible designation of a biosimilar as “interchangeable” based on its similarity to a licensed biologic. Under the BPCIA, an application for a biosimilar product cannot be licensed by the FDA until 12 years after the reference product was licensed under a BLA. The law is complex and is still being interpreted and implemented by the FDA. In addition, as discussed more fully below, since the BPCIA was enacted as part of the ACA, if the ACA is invalidated in its entirety as unconstitutional, then the BPCIA could be considered invalid as well. While it is uncertain when such processes intended to implement the BPCIA may be fully adopted by the FDA, any such processes could have a material adverse effect on the future commercial prospects for our biological product candidates.

We believe that any of the product candidates we develop that is licensed in the United States as a biological product under a BLA should qualify for the 12-year period of exclusivity. However, there is a risk that this exclusivity could be shortened due to congressional action or otherwise, or that the FDA will not consider the subject product candidates to be reference products for competing products, potentially creating the opportunity for generic competition sooner than anticipated. Moreover, the extent to which a biosimilar, once licensed, will be substituted for any one of the reference products in a way that is similar to traditional generic substitution for non-biological products is not yet clear, and will depend on a number of marketplace and regulatory factors that are still developing.

The regulatory landscape that will govern our product candidates is uncertain; regulations relating to more established cell therapies and other therapies for B cell-mediated autoimmune diseases are still developing, and changes in regulatory requirements could result in delays or discontinuation of development of our product candidates or unexpected costs in obtaining regulatory approval.

Because we are developing novel CAAR T cell product candidates that are unique biological entities, the regulatory requirements that we will be subject to are not entirely clear. Even with respect to more established products that fit into the categories of gene therapies or cell therapies, the regulatory landscape is still developing. For example, regulatory requirements governing gene therapy products and cell therapy products have changed frequently and may continue to change in the future. Moreover, there is substantial, and sometimes uncoordinated, overlap in those responsible for regulation of existing gene therapy products and cell therapy products. For example, in the United States, the FDA has established the Office of Tissues and Advanced Therapies, formerly known as the Office of Cellular, Tissue and Gene Therapies, within its Center for Biologics Evaluation and Research, or CBER, to consolidate the review of gene therapy and related products, and the Cellular, Tissue and Gene Therapies Advisory Committee to advise CBER on its review. Gene therapy clinical trials are also subject to review and oversight by an institutional biosafety committee, a local institutional committee that reviews and oversees basic and clinical research conducted at the institution participating in the clinical trial. Although the FDA decides whether individual gene therapy protocols may proceed, review process and determinations of other reviewing bodies can impede or delay the initiation of a clinical study, even if the FDA has reviewed the study and approved its initiation. Conversely, the FDA can place an IND application on clinical hold even if such other entities have provided a favorable review. Furthermore, each clinical trial must be reviewed and approved by an independent IRB at or servicing each institution at which a clinical trial will be conducted. In addition, adverse developments in clinical trials of gene therapy products conducted by others may cause the FDA or other regulatory bodies to change the requirements for approval of any of our product candidates.

Complex regulatory environments exist in other jurisdictions in which we might consider seeking regulatory approvals for our product candidates, further complicating the regulatory landscape. For example, in the European Union, a special committee called the Committee for Advanced Therapies was established within the EMA in accordance with Regulation (EC) No 1394/2007 on advanced-therapy medicinal products, or ATMPs, to assess the quality, safety and efficacy of ATMPs, and to follow scientific developments in the field. ATMPs include gene therapy products as well as somatic cell therapy products and tissue engineered products. These various regulatory

review committees and advisory groups and new or revised guidelines that they promulgate from time to time may lengthen the regulatory review process, require us to perform additional studies, increase our development costs, lead to changes in regulatory positions and interpretations, delay or prevent approval and commercialization of our product candidates or lead to significant post-approval limitations or restrictions. Because the regulatory landscape for our CAAR T cell product candidates is new, we may face even more cumbersome and complex regulations than those emerging for gene therapy products and cell therapy products. Furthermore, even if our product candidates obtain required regulatory approvals, such approvals may later be withdrawn because of changes in regulations or the interpretation of regulations by applicable regulatory agencies. Delay or failure to obtain, or unexpected costs in obtaining, the regulatory approval necessary to bring a potential product to market could decrease our ability to generate sufficient product revenue to maintain our business.

If we are not able to obtain, or if there are delays in obtaining, required regulatory approvals for our product candidates, we will not be able to commercialize, or will be delayed in commercializing, our product candidates, and our ability to generate revenue will be materially impaired.

Our product candidates and the activities associated with their development and commercialization, including their design, testing, manufacture, safety, efficacy, recordkeeping, labeling, storage, approval, advertising, promotion, sale, distribution, import and export are subject to comprehensive regulation by the FDA and other regulatory agencies in the United States. Before we can commercialize any of our product candidates, we must obtain marketing approval. We have not received approval to market any of our product candidates from regulatory authorities in any jurisdiction and it is possible that none of our product candidates or any product candidates we may seek to develop in the future will ever obtain regulatory approval. We, as a company, have no experience in filing and supporting the applications necessary to gain regulatory approvals and expect to rely on third-party CROs and/or regulatory consultants to assist us in this process. Securing regulatory approval requires the submission of extensive preclinical and clinical data and supporting information to the various regulatory authorities for each therapeutic indication to establish the drug candidate's safety, potency and purity.

Securing regulatory approval also requires the submission of information about the drug manufacturing process to, and inspection of manufacturing facilities by, the relevant regulatory authority. Our product candidates may not be effective, may be only moderately effective or may prove to have undesirable or unintended side effects, toxicities or other characteristics that may preclude our obtaining marketing approval or prevent or limit commercial use.

The process of obtaining regulatory approvals is expensive, may take many years if additional clinical trials are required, if approval is obtained at all, and can vary substantially based upon a variety of factors, including the type, complexity and novelty of the product candidates involved. Changes in marketing approval policies during the development period, changes in or the enactment of additional statutes or regulations, or changes in regulatory review for each submitted IND, BLA or equivalent application types, may cause delays in the approval or rejection of an application. The FDA has substantial discretion in the approval process and may refuse to accept any application or may decide that our data are insufficient for approval and require additional preclinical, clinical or other studies. Our product candidates could be delayed in receiving, or fail to receive, regulatory approval for many reasons, including the following:

- the FDA may disagree with the design or implementation of our clinical trials;
- we may be unable to demonstrate to the satisfaction of the FDA that a drug candidate is safe, potent and pure for its proposed indication or a related companion diagnostic is suitable to identify appropriate patient populations;
- the results of clinical trials may not meet the level of statistical significance required by the FDA for approval;
- we may be unable to demonstrate that a product candidate's clinical and other benefits outweigh its safety risks;
- the FDA may disagree with our 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 an BLA or other submission or to obtain regulatory approval in the United States or elsewhere;
- the FDA may fail to approve the manufacturing processes, test procedures and specifications, or facilities that we may establish or of third-party manufacturers with which we may contract for clinical and commercial supplies; and
- the approval policies or regulations of the FDA may significantly change in a manner rendering our clinical data insufficient for approval.

Of the large number of drugs in development, only a small percentage successfully complete the FDA approval process and are commercialized. The lengthy approval process as well as the unpredictability of future clinical trial results may result in our failing to obtain regulatory approval to market our product candidates, which would significantly harm our business, results of operations and prospects.

We expect the novel nature of our product candidates to create further challenges in obtaining regulatory approval. As a result, our ability to develop product candidates and obtain regulatory approval may be significantly impacted. For example, the general approach for FDA approval of a new biologic or drug is for sponsors to seek licensure or approval based on dispositive data from well-controlled, Phase 3 clinical trials of the relevant product candidate in the relevant patient population. Phase 3 clinical trials typically involve hundreds of patients, have significant costs and take years to complete. We believe that we may be able to utilize the FDA's Regenerative Medicine Advanced Therapy designation for our product candidates given the limited alternatives for treatments for certain rare diseases and B cell-mediated autoimmune diseases, but the FDA may not agree with our plans.

Moreover, approval of genetic or biomarker diagnostic tests may be necessary to advance some of our product candidates to clinical trials or potential commercialization. In the future, regulatory agencies may require the development and approval of such tests. Accordingly, the regulatory approval pathway for such product candidates may be uncertain, complex, expensive and lengthy, and approval may not be obtained.

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

If we experience delays in obtaining approval or if we fail to obtain approval of our product candidates, the commercial prospects for our product candidates may be harmed and our ability to generate revenues will be materially impaired.

Even though we may apply for orphan drug designation for our product candidates, we may not be able to obtain orphan drug marketing exclusivity.

Under the Orphan Drug Act, the FDA may grant orphan designation to a drug or biologic intended to treat a rare disease or condition, defined as a disease or condition with a patient population of fewer than 200,000 in the United States, or a patient population of 200,000 or more in the United States when there is no reasonable expectation that the cost of developing and making available the drug or biologic in the United States will be recovered from sales in the United States for that drug or biologic. In order to obtain orphan drug designation, the request must be made before submitting a BLA. In the United States, orphan drug designation entitles a party to financial incentives such as opportunities for grant funding towards clinical trial costs, tax advantages, and user-fee waivers. After the FDA grants orphan drug designation, the generic identity of the drug and its potential orphan use are disclosed publicly by the FDA. Orphan drug designation does not convey any advantage in, or shorten the duration of, the regulatory review and approval process.

If a product that has orphan drug designation subsequently receives the first FDA approval of that particular product for the disease 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, including a BLA, to market the same biologic (meaning, a product with the same principal molecular structural features) for the same indication for seven years, except in limited circumstances such as a showing of clinical superiority to the product with orphan drug exclusivity or if FDA finds that the holder of the orphan drug exclusivity has not shown that it can assure the availability of sufficient quantities of the orphan drug to meet the needs of patients with the disease or condition for which the drug was designated. As a result, even if one of our product candidates receives orphan exclusivity, the FDA can still approve other biologics that do not have the same principal molecular structural features for use in treating the same indication or disease or the same biologic for a different indication or disease during the exclusivity period. Furthermore, the FDA can waive orphan exclusivity if we are unable to manufacture sufficient supply of our product or if a subsequent applicant demonstrates clinical superiority over our product.

We have obtained from the FDA orphan drug designation for DSG3-CAART for the treatment of pemphigus vulgaris (PV). We may seek orphan drug designation for certain other of our product candidates, but may be unable to obtain orphan drug designation for some or all of our product candidates in specific orphan indications in which we believe there is a medically plausible basis for the use of these products. Even if we obtain orphan drug designation, exclusive marketing rights in the United States may be limited if we seek approval for an indication broader than the orphan designated indication and may be lost if the FDA later determines that the request for designation was materially defective or if we are unable to assure sufficient quantities of the product to meet the needs of patients with the rare disease or condition, or if a subsequent applicant demonstrates clinical superiority over our products, if licensed. In addition, although we may seek orphan drug designation for other product candidates, we may never receive such designations.

A fast track designation by the FDA, even if granted, may not lead to a faster development or regulatory review or approval process, and does not increase the likelihood that our current product candidate and any future product candidates will receive marketing approval.

If a drug is intended for the treatment of a serious or life-threatening condition and the drug demonstrates the potential to address unmet medical needs for this condition, the drug sponsor may apply for FDA fast track designation for a particular indication. Fast track is a process designed to facilitate the development, and expedite the review of drugs to treat serious or life-threatening conditions and address an unmet medical need. We have received fast track designation for DSG3-CAART for improving healing of mucosal blisters in patients with mPV. We may also apply for fast track designation for certain of our other product candidates, but there is no assurance that the FDA will grant this status to any of our other current or future product candidates. Marketing applications filed by sponsors of products in fast track development may qualify for priority review under the policies and procedures offered by the FDA, but the fast track designation does not assure any such qualification or ultimate marketing approval by the FDA. The FDA has broad discretion whether or not to grant fast track designation, so even if we believe a particular product candidate is eligible for this designation, there can be no assurance that the FDA would decide to grant it. Even though we have received fast track designation for DSG3-CAART for improving healing of mucosal blisters in patients with mPV, we may not experience a faster development process, regulatory review or approval compared to conventional FDA procedures, and receiving a fast track designation does not provide assurance of ultimate FDA approval. In addition, the FDA may withdraw fast track designation if it believes that the designation is no longer supported by data from our clinical development program. In addition, the FDA may withdraw any fast track designation at any time.

Although we may pursue expedited regulatory approval pathways for a product candidate, it may not qualify for expedited development or, if it does qualify for expedited development, it may not actually lead to a faster development or regulatory review or approval process.

Although we believe there may be an opportunity to accelerate the development of certain of our product candidates through one or more of the FDA's expedited programs, such as fast track, breakthrough therapy, Regenerative Medicine Advanced Therapy, accelerated approval or priority review, we cannot be assured that any of our product candidates will qualify for such programs.

For example, we may seek a Regenerative Medicine Advanced Therapy, or RMAT, designation for some of our product candidates. An RMAT is defined as cell therapies, therapeutic tissue engineering products, human cell and tissue products, and combination products using any such therapies or products. Gene therapies, including genetically modified cells that lead to a durable modification of cells or tissues may meet the definition of a Regenerative Medicine Therapy. The RMAT program is intended to facilitate efficient development and expedite review of RMATs, which are intended to treat, modify, reverse, or cure a serious or life-threatening disease or condition. A new drug application or a BLA for an RMAT may be eligible for priority review or accelerated approval through (1) surrogate or intermediate endpoints reasonably likely to predict long-term clinical benefit or (2) reliance upon data obtained from a meaningful number of sites. Benefits of such designation also include early interactions with FDA to discuss any potential surrogate or intermediate endpoint to be used to support accelerated approval. A Regenerative Medicine Therapy that is granted accelerated approval and is subject to post-approval requirements may fulfill such requirements through the submission of clinical evidence, clinical studies, patient registries, or other sources of real world evidence, such as electronic health records; the collection of larger confirmatory data sets; or post-approval monitoring of all patients treated with such therapy prior to its approval. Although RMAT designation or access to any other expedited program may expedite the development or approval process, it does not change the standards for approval. If we apply for RMAT designation or any other expedited program for our product candidates, the FDA may determine that our proposed target indication or other aspects of our clinical development plans do not qualify for such expedited program. Even if we are successful in obtaining a RMAT designation or access to any other expedited program, we may not experience faster development timelines or achieve faster review or approval compared to conventional FDA procedures. Access to an expedited program may also be withdrawn by the FDA if it believes that the designation is no longer supported by data from our clinical development program. Additionally, qualification for any expedited review procedure does not ensure that we will ultimately obtain regulatory approval for such product candidate.

at the FDA, the SEC and other government agencies caused by funding shortages or global health concerns could hinder their ability to hire and retain key leadership and other personnel, prevent new products and services from being developed or commercialized in a timely manner or otherwise prevent those agencies from performing normal business functions on which the operation of our business may rely, which could negatively impact our business.

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

Disruptions at the FDA and other agencies may also slow the time necessary for new drugs or biologics to be reviewed and/or approved by necessary government agencies, which would adversely affect our business. For example, over the last several years, including most recently from December 22, 2018 to January 25, 2019, the U.S. government has shut down several times and certain regulatory agencies, such as the FDA and the SEC, have had to furlough critical FDA, SEC and other government employees and stop critical activities. If a prolonged government shutdown occurs, it could significantly impact the ability of the FDA to timely review and process our regulatory submissions, which could have a material adverse effect on our business.

Separately, in response to the COVID-19 pandemic, on March 10, 2020 the FDA announced its intention to postpone most inspections of foreign manufacturing facilities and products while local, national and international conditions warrant. On March 18, 2020, the FDA announced its intention to temporarily postpone routine surveillance inspections of domestic manufacturing facilities and provided guidance regarding the conduct of clinical trials which the FDA continues to update. As of June 23, 2020, the FDA noted it was continuing to ensure timely reviews of applications for medical products during the COVID-19 pandemic in line with its user fee performance goals; however, FDA may not be able to continue its current pace and approval timelines could be extended, including where a pre-approval inspection or an inspection of clinical sites is required and due to the COVID-19 pandemic and travel restrictions FDA is unable to complete such required inspections during the review period. On July 10, 2020, the FDA announced its goal of restarting domestic on-site inspections during the week of

July 20, but such activities will depend on data about the virus' trajectory in a given state and locality and the rules and guidelines that are put in place by state and local governments. The FDA has developed a rating system to assist in determining when and where it is safest to conduct prioritized domestic inspections. Should FDA determine that an inspection is necessary for approval and an inspection cannot be completed during the review cycle due to restrictions on travel, FDA has stated that it generally intends to issue a complete response letter. Further, if there is inadequate information to make a determination on the acceptability of a facility, FDA may defer action on the application until an inspection can be completed. In 2020, several companies announced receipt of complete response letters due to the FDA's inability to complete required inspections for their applications. Regulatory authorities outside the U.S. may adopt similar restrictions or other policy measures in response to the COVID-19 pandemic and may experience delays in their regulatory activities.

Risks Related to Ongoing Regulatory Obligations

Even if we receive regulatory approval of our product candidates, we will be subject to ongoing regulatory obligations and continued regulatory review, which may result in significant additional expense and we may be subject to penalties if we fail to comply with regulatory requirements or experience unanticipated problems with our product candidates.

Any regulatory approvals that we receive for our product candidates will require surveillance to monitor the safety, potency and purity of the product candidate. We believe it is likely that the FDA will require a Risk Evaluation and Mitigation Strategy, or REMS, in order to approve our product candidates, which could entail requirements for a medication guide, physician communication plans or additional elements to assure safe use, such as restricted distribution methods, patient registries and other risk minimization tools. In addition, if the FDA approves our product candidates, the manufacturing processes, labeling, packaging, distribution, adverse event reporting, storage, advertising, promotion, import, export and recordkeeping for our product candidates will be subject to extensive and ongoing regulatory requirements. These requirements include submissions of safety and other post-marketing information and reports, registration, as well as continued compliance with cGMPs and cGCPs for any clinical trials that we conduct post-approval. As such, we and our contract manufacturers will be subject to continual review and inspections to assess compliance with cGMP and adherence to commitments made in any BLA, other marketing application and previous responses to inspectional observations. Accordingly, we and others with whom we work must continue to expend time, money and effort in all areas of regulatory compliance, including manufacturing, production and quality control. In addition, the FDA could require us to conduct another study to obtain additional safety or biomarker information.

Further, we will be required to comply with FDA promotion and advertising rules, which include, among others, standards for direct-to-consumer advertising, restrictions on promoting products for uses or in patient populations that are not described in the product's approved uses (known as "off-label use"), limitations on industry-sponsored scientific and educational activities and requirements for promotional activities involving the internet and social media. Later discovery of previously unknown problems with our product candidates through follow-up programs with our clinical trial patients, including adverse events of unanticipated severity or frequency, or with our third-party suppliers or manufacturing processes, or failure to comply with regulatory requirements, may result in revisions to the approved labeling to add new safety information, imposition of post-market studies or clinical studies to assess new safety risks, or imposition of distribution restrictions or other restrictions under a REMS program. Other potential consequences include, among other things:

- restrictions on the marketing or manufacturing of our product candidates, withdrawal of the product from the market or voluntary or mandatory product recalls;
- fines, warning letters or holds on clinical trials;
- refusal by the FDA to approve pending applications or supplements to approved applications filed by us or suspension or revocation of license approvals;
- product seizure or detention, or refusal to permit the import or export of our product candidates; and
- injunctions or the imposition of civil or criminal penalties.

The FDA's policies may change and additional government regulations may be enacted that could prevent, limit or delay regulatory approval of our product candidates. We cannot predict the likelihood, nature or extent of government regulation that may arise from future legislation or administrative or executive action. For example, certain policies of the current U.S. President's administration may impact our business and industry. Namely, the current U.S. President's administration has taken several executive actions, including the issuance of a number of Executive Orders, that could, for example, result in changes to the FDA's priorities and allocation of resources to respond to the COVID-19 pandemic. It is difficult to predict how these orders will be implemented, and the extent to which they will impact the FDA's ability to exercise its regulatory authority. If these executive actions impose restrictions on FDA's ability to engage in oversight and implementation activities in the normal course, our business may be negatively impacted. If we are slow or unable to adapt to changes in existing requirements or the adoption of new requirements or policies, or if we are not able to maintain regulatory compliance, we may lose any marketing approval that we may have obtained, and we may not achieve or sustain profitability.

If we fail to comply with environmental, health and safety laws and regulations, we could become subject to fines or penalties or incur costs that could have a material adverse effect on the success of our business.

We are subject to numerous environmental, health and safety laws and regulations, including those governing laboratory procedures and the handling, use, storage, treatment and disposal of hazardous materials and wastes. Our research and development activities involve the use of biological and hazardous materials and produce hazardous waste products. We generally contract with third parties for the disposal of these materials and wastes. We cannot eliminate the risk of contamination or injury from these materials, which could cause an interruption of our commercialization efforts, research and development efforts and business operations, environmental damage resulting in costly clean-up and liabilities under applicable laws and regulations governing the use, storage, handling and disposal of these materials and specified waste products. Although we believe that the safety procedures utilized by our third-party manufacturers for handling and disposing of these materials generally comply with the standards prescribed by these laws and regulations, we cannot guarantee that this is the case or eliminate the risk of accidental contamination or injury from these materials. In such an event, we may be held liable for any resulting damages and such liability could exceed our resources and state or federal or other applicable authorities may curtail our use of certain materials and/or interrupt our business operations. Furthermore, environmental laws and regulations are complex, change frequently and have tended to become more stringent. We cannot predict the impact of such changes and cannot be certain of our future compliance. Breach of certain environmental, health and safety laws and regulations could also in certain circumstances constitute a breach of our License Agreement with Penn. In addition, we may incur substantial costs in order to comply with current or future environmental, health and safety laws and regulations. These current or future laws and regulations may impair our research, development or production efforts. Failure to comply with these laws and regulations also may result in substantial fines, penalties or other sanctions.

Although we maintain workers' compensation insurance to cover us for costs and expenses, we may incur due to injuries to our employees resulting from the use of hazardous materials or other work-related injuries, this insurance may not provide adequate coverage against potential liabilities. We do not carry specific biological waste or hazardous waste insurance coverage, workers compensation or property and casualty and general liability insurance policies that include coverage for damages and fines arising from biological or hazardous waste exposure or contamination.

Our employees, independent contractors, consultants, commercial partners and vendors may engage in misconduct or other improper activities, including noncompliance with regulatory standards and requirements.

We are exposed to the risk of employee fraud or other illegal activity by our employees, independent contractors, consultants, commercial partners and vendors. Misconduct by these parties could include intentional, reckless and/or negligent conduct that fails to comply with the laws of the FDA, provide true, complete and accurate information to the FDA, comply with manufacturing standards we have established, comply with healthcare fraud and abuse laws in the United States and similar foreign fraudulent misconduct laws, or report financial information or data accurately or to disclose unauthorized activities to us. If we obtain FDA approval of any of our product candidates and begin commercializing those products in the United States, our potential exposure under such laws will increase significantly, and our costs associated with compliance with such laws are also likely to increase. These laws may impact, among other things, our current activities with principal investigators and research patients, as well as proposed and future sales, marketing and education programs.

Risks Related to Healthcare

Coverage and reimbursement may be limited or unavailable in certain market segments for our product candidates, which could make it difficult for us to sell our product candidates, if licensed, profitably.

Successful commercialization of our product candidates, if licensed, will depend in part on the extent to which reimbursement for those drug products will be available from government health administration authorities, private health insurers, and other organizations. Government authorities and third-party payors, such as private health insurers and health maintenance organizations, decide which drug products they will pay for and establish reimbursement levels. The availability and extent of reimbursement by governmental and private payors is essential for most patients to be able to afford a drug product. Sales of drug products depend substantially, both domestically and abroad, on the extent to which the costs of drugs products are paid for by health maintenance, managed care, pharmacy benefit and similar healthcare management organizations, or reimbursed by government health administration authorities, private health coverage insurers and other third-party payors. Significant uncertainty exists as to the coverage and reimbursement status of any product candidates for which we obtain regulatory approval. Any product candidate for which we seek regulatory approval and reimbursement will need to meet or surpass our target product profile, or TPP, to be deemed a viable alternative to currently approved therapies. In addition, because our product candidates represent new approaches to the treatment of B cell-mediated autoimmune diseases, we cannot accurately estimate the potential revenue from our product candidates.

Third-party payors decide which drugs and treatments they will cover and the amount of reimbursement. Reimbursement by a third-party payor may depend upon a number of factors, including, but not limited to, the third-party payor's determination that use of a product is:

- a covered benefit under its health plan;
- safe, effective and medically necessary;
- appropriate for the specific patient;
- cost-effective; and
- neither experimental nor investigational.

Obtaining coverage and reimbursement of a product from a government or other third-party payor is a time-consuming and costly process that could require us to provide the payor with supporting scientific, clinical and cost-effectiveness data for the use of our products, if licensed. In the United States, the principal decisions about reimbursement for new drug products are typically made by the Centers for Medicare and Medicaid Services, or CMS, an agency within the U.S. Department of Health and Human Services, or HHS. CMS decides whether and to what extent a new drug product will be covered and reimbursed under Medicare, and private payors tend to follow CMS to a substantial degree. However, no uniform policy of coverage and reimbursement for drug products exists among third-party payors and coverage and reimbursement levels for drug products can differ significantly from payor to payor. Further, one payor's determination to provide coverage for a product does not assure that other payors will also provide coverage for the product. 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.

Even if we obtain coverage for a given product, if the resulting reimbursement rates are insufficient, hospitals may not approve our product for use in their facility or third-party payors may require co-payments that patients find unacceptably high. Patients are unlikely to use our product candidates unless coverage is provided and reimbursement is adequate to cover a significant portion of the cost of our product candidates. Separate reimbursement for the product itself may or may not be available. Instead, the hospital or administering physician may be reimbursed only for providing the treatment or procedure in which our product is used. Further, from time to time, CMS revises the reimbursement systems used to reimburse health care providers, including the Medicare Physician Fee Schedule and Outpatient Prospective Payment System, which may result in reduced Medicare payments. In some cases, private third-party payors rely on all or portions of Medicare payment systems to determine payment rates. Changes to government healthcare programs that reduce payments under these programs may negatively impact payments from private third-party payors, and reduce the willingness of physicians to use our product candidates.

The marketability of any product candidates for which we receive regulatory approval for commercial sale may suffer if government and other third-party payors fail to provide coverage and adequate reimbursement. We expect downward pressure on pharmaceutical pricing to continue. Further, coverage policies and third-party reimbursement rates may change at any time. Even if favorable coverage and reimbursement status is attained for one or more products for which we receive regulatory approval, less favorable coverage policies and reimbursement rates may be implemented in the future.

Healthcare legislative measures aimed at reducing healthcare costs may have a material adverse effect on our business and results of operations.

In the United States, there have been a number of legislative and regulatory changes and proposed changes regarding the healthcare system that could prevent or delay regulatory approval of our product candidates, restrict or regulate post-approval activities and affect our ability to profitably sell any product candidates for which we obtain regulatory approval. We expect that current laws, as well as other healthcare reform measures that may be adopted in the future, may result in additional reductions in Medicare and other healthcare funding, more rigorous coverage criteria, new payment methodologies and in additional downward pressure on the price that we, or any collaborators, may receive for any approved products.

In March 2010, President Obama signed into law the ACA. Among the provisions of the ACA of potential importance to our business and our product candidates are the following:

- an annual, non-deductible fee on any entity that manufactures or imports specified branded prescription products and biologic products;
- an increase in the statutory minimum rebates a manufacturer must pay under the Medicaid Drug Rebate Program;
- a new methodology by which rebates owed by manufacturers under the Medicaid Drug Rebate Program are calculated for products that are inhaled, infused, instilled, implanted or injected;
- expansion of healthcare fraud and abuse laws, including the civil False Claims Act and the federal Anti-Kickback Statute, new government investigative powers and enhanced penalties for noncompliance;
- a new Medicare Part D coverage gap discount program, in which manufacturers must agree to offer 50% (increased to 70% as of January 1, 2019) point-of-sale discounts off negotiated prices of applicable brand products to eligible beneficiaries during their coverage gap period, as a condition for the manufacturer's outpatient products to be covered under Medicare Part D;
- extension of manufacturers' Medicaid rebate liability to individuals enrolled in Medicaid managed care organizations;
- expansion of the entities eligible for discounts under the Public Health Service pharmaceutical pricing program;
- new requirements to report certain financial arrangements with physicians and teaching hospitals;
- a new requirement to annually report product samples that manufacturers and distributors provide to physicians;
- a new Patient-Centered Outcomes Research Institute to oversee, identify priorities in, and conduct comparative clinical effectiveness research, along with funding for such research; and
- established the Center for Medicare and Medicaid Innovation within CMS to test innovative payment and service delivery models.

Since its enactment, there have been numerous judicial, administrative, executive, and legislative challenges to certain aspects of the ACA, and we expect there will be additional challenges and amendments to the ACA in the future. For example, various portions of the ACA are currently undergoing legal and constitutional challenges in the Fifth Circuit Court and the United States Supreme Court. Additionally, the Trump Administration issued various Executive Orders which eliminated cost sharing subsidies and various provisions that would impose a fiscal burden on states or a cost, fee, tax, penalty or regulatory burden on individuals, healthcare providers, health insurers, or manufacturers of pharmaceuticals or medical devices, and Congress has introduced several pieces of legislation aimed at significantly revising or repealing the ACA. It is unclear whether the ACA will be overturned, repealed, replaced, or further amended, especially under the Biden administration. We cannot predict what affect further changes to the ACA would have on our business.

Further legislation or regulation could be passed that could harm our business, financial condition and results of operations. Other legislative changes have been proposed and adopted since the Affordable Care Act was enacted. For example, in August 2011, President Obama signed into law the Budget Control Act of 2011, which, among other things included aggregate reductions to Medicare payments to providers of 2% per fiscal year, which went into effect in April 2013 and will remain in effect through 2030 unless additional Congressional action is taken. Pursuant to the Coronavirus Aid, Relief, and Economic Security Act, also known as the CARES Act, as well as subsequent legislation, these reductions have been suspended from May 1, 2020 through March 31, 2021 due to the COVID-19 pandemic. Proposed legislation, if passed, would extend this suspension until the end of the pandemic. In January 2013, the American Taxpayer Relief Act of 2012 was signed into law, which, among other things, further reduced Medicare payments to several types of providers, including hospitals, imaging centers and treatment centers, and increased the statute of limitations period for the government to recover overpayments to providers from three to five years. These new laws and regulations may result in additional reductions in Medicare and other healthcare funding and otherwise affect the prices we may obtain for any of our product candidates for which we may obtain regulatory approval or the frequency with which any such product candidate is prescribed or used.

There have been, and likely will continue to be, legislative and regulatory proposals at the foreign, federal and state levels directed at broadening the availability of healthcare and containing or lowering the cost of healthcare. The implementation of cost containment measures or other healthcare reforms may prevent us from being able to generate revenue, attain profitability, or commercialize our product candidates. Such reforms could have an adverse effect on anticipated revenue from product candidates that we may successfully develop and for which we may obtain regulatory approval and may affect our overall financial condition and ability to develop product candidates.

In addition, there has been increasing legislative and enforcement interest in the United States with respect to specialty drug pricing practices. Specifically, there have been several recent U.S. Congressional inquiries and proposed and enacted federal and state legislation designed to, among other things, bring more transparency to drug pricing, review the relationship between pricing and manufacturer patient assistance programs, and reform government program reimbursement methodologies for drugs. For example, the Trump administration's budget proposal for fiscal year 2021 included a \$135 billion allowance to support legislative proposals seeking to reduce drug prices, increase competition, lower out-of-pocket drug costs for patients, and increase patient access to lower-cost generic and biosimilar drugs. On March 10, 2020, the Trump administration sent "principles" for drug pricing to Congress, calling for legislation that would, among other things, cap Medicare Part D beneficiary out-of-pocket pharmacy expenses, provide an option to cap Medicare Part D beneficiary monthly out-of-pocket expenses, and place limits on pharmaceutical price increases. Further, the Trump administration also previously released a "Blueprint", or plan, to lower drug prices and reduce out of pocket costs of drugs that contains additional proposals to increase drug manufacturer competition, increase the negotiating power of certain federal healthcare programs, incentivize manufacturers to lower the list price of their products, and reduce the out of pocket costs of drug products paid by consumers. HHS has already started the process of soliciting feedback on some of these measures and, at the same, is immediately implementing others under its existing authority. For example, in May 2019, CMS issued a final rule to allow Medicare Advantage Plans the option of using step therapy, a type of prior authorization, for Part B drugs beginning January 1, 2020. This final rule codified CMS's policy change that was effective January 1, 2019. It is unclear whether the Biden administration will challenge, reverse, revoke or otherwise modify these executive and administrative actions after January 20, 2021. In addition, there have been several changes to the 340B drug pricing program, which imposes ceilings on prices that drug manufacturers can charge for medications sold to certain health care facilities. On December 27, 2018, the District Court for the District of Columbia invalidated a reimbursement formula change under the 340B drug pricing program, and CMS subsequently altered the FYs 2019 and 2018 reimbursement formula on specified covered outpatient drugs ("SCODs"). The court ruled this change was not an "adjustment" which was within the Secretary's discretion to make but was instead a fundamental change in the reimbursement calculation. However, most recently, on July 31, 2020, the U.S. Court of Appeals for the District of Columbia Circuit overturned the district court's decision and found that the changes were within the Secretary's authority. On September 14, 2020, the plaintiffs-appellees filed a Petition for Rehearing En Banc (i.e., before the full court), but was denied on October 16, 2020. It is unclear how these developments could affect covered hospitals who might purchase our future products and affect the rates we may charge such facilities for our approved products in the future, if any.

On July 24, 2020 and September 13, 2020, President Trump announced several executive orders related to prescription drug pricing that seek to implement several of the administration's proposals. In response, the FDA

released a final rule on September 24, 2020, which went into effect on November 30, 2020, providing guidance for states to build and submit importation plans for drugs from Canada. Further, on November 20, 2020 CMS issued an Interim Final Rule implementing the Most Favored Nation, or MFN, Model under which Medicare Part B reimbursement rates will be calculated for certain drugs and biologicals based on the lowest price drug manufacturers receive in Organization for Economic Cooperation and Development countries with a similar gross domestic product per capita. The MFN Model regulations mandate participation by identified Part B providers and will apply in all U.S. states and territories for a seven-year period beginning January 1, 2021, and ending December 31, 2027. The Interim Final Rule has not been finalized and is subject to revision and challenge. Additionally, on November 20, 2020, HHS finalized a regulation removing safe harbor protection for price reductions from pharmaceutical manufacturers to plan sponsors under Part D, either directly or through pharmacy benefit managers, unless the price reduction is required by law. The rule also creates a new safe harbor for price reductions reflected at the point-of-sale, as well as a safe harbor for certain fixed fee arrangements between pharmacy benefit managers and manufacturers. Implementation of the amendments to the discount safe harbor have been delayed until at least January 1, 2023. Although a number of these, and other proposed measures may require authorization through additional legislation to become effective, and the Biden Administration may reverse or otherwise change these measures, Congress has indicated that it will continue to seek new legislative and/or administrative measures to control drug costs. Individual states in the United States have also become increasingly active in passing legislation and implementing regulations designed to control pharmaceutical product pricing, including price or patient reimbursement constraints, discounts, restrictions on certain product access and marketing cost disclosure and transparency measures, and, in some cases, designed to encourage importation from other countries and bulk purchasing.

There have been, and likely will continue to be, legislative and regulatory proposals at the foreign, federal and state levels directed at containing or lowering the cost of healthcare. For example, in 2016, the United Kingdom referendum on its membership in the EU resulted in a majority of the United Kingdom voters voting to exit the EU, often referred to as “Brexit”. Pursuant to Article 50 of the Treaty on European Union, the United Kingdom ceased being a Member State of the European Union on January 31, 2020. A transition period began February 1, 2020 and continued until December 31, 2020, during which most laws of the EU continued to apply to the United Kingdom, including the European Union’s rules, the European Union’s pharmaceutical laws. The United Kingdom and the EU have signed a EU-UK Trade and Cooperation Agreement, which became provisionally applicable on 1 January 1, 2021 and will become formally applicable once ratified by both the United Kingdom and the EU. This agreement provides details on how some aspects of the United Kingdom’s and EU’s relationship will operate going forwards however there are still many uncertainties. Brexit has already and may continue to adversely affect European and/or worldwide regulatory conditions. Brexit could lead to legal uncertainty and potentially divergent national laws and regulations in Europe, including those related to the pricing of prescription pharmaceuticals, as the United Kingdom determines which EU laws to replicate or replace, which could impair our ability to transact business in the EU and the United Kingdom in the future, if we elect to seek regulatory approval and commercialize any of our products there, if approved. The implementation of cost containment measures or other healthcare reforms may prevent us from being able to generate revenue, attain profitability, or commercialize our product. Such reforms could have an adverse effect on anticipated revenue from product candidates that we may successfully develop and for which we may obtain regulatory approval and may affect our overall financial condition and ability to develop product candidates.

We cannot predict the initiatives that may be adopted in the future. The continuing efforts of the government, insurance companies, managed care organizations and other payors of healthcare services to contain or reduce costs of healthcare and/or impose price controls may adversely affect:

- the demand for our product candidates, if we obtain regulatory approval;
- our ability to set a price that we believe is fair for our products, if licensed;
- our ability to generate revenue and achieve or maintain profitability;
- the level of taxes that we are required to pay; and
- the availability of capital.

Any reduction in reimbursement from Medicare or other government programs may result in a similar reduction in payments from private payors, which may adversely affect our future profitability.

Our relationships with customers, healthcare providers, physicians, and third-party payors will be subject, directly or indirectly, to federal and state healthcare fraud and abuse laws, false claims laws, health information privacy and security laws, and other healthcare laws and regulations. If we or our employees, independent contractors, consultants, commercial partners and vendors violate these laws, we could face substantial penalties.

These laws may impact, among other things, our clinical research program, as well as our proposed and future sales, marketing and education programs. In particular, the promotion, sales and marketing of healthcare items and services is subject to extensive laws and regulations designed to prevent fraud, kickbacks, self-dealing and other abusive practices, including, without limitation, the federal Anti-Kickback Statute and the federal False Claims Act, which may constrain the business or financial arrangements and relationships through which such companies sell, market and distribute pharmaceutical products. These laws and regulations may restrict or prohibit a wide range of pricing, discounting, marketing and promotion, sales commission, customer incentive and other business arrangements. We may also be subject to federal, state and foreign laws governing the privacy and security of individual identifiable health information and other personally identifiable information. The U.S. healthcare laws and regulations that may affect our ability to operate include, but are not limited to:

- the federal Anti-Kickback Statute, which prohibits, among other things, knowingly and willfully soliciting, receiving, offering or paying any remuneration (including any kickback, bribe or rebate), directly or indirectly, overtly or covertly, in cash or in kind, to induce, or in return for, either the referral of an individual, or the purchase, lease, order or recommendation of any good, facility, item or service for which payment may be made, in whole or in part, under a federal healthcare program, such as the Medicare and Medicaid programs. A person or entity can be found guilty of violating the statute without actual knowledge of the statute or specific intent to violate it. In addition, a claim including items or services resulting from a violation of the federal Anti-Kickback Statute constitutes a false or fraudulent claim for purposes of the False Claims Act, or FCA. The Anti-Kickback Statute has been interpreted to apply to arrangements between pharmaceutical manufacturers on the one hand and prescribers, purchasers, and formulary managers on the other. There are a number of statutory exceptions and regulatory safe harbors protecting some common activities from prosecution. On November 20, 2020, OIG finalized further modifications to the federal Anti-Kickback Statute. Under the final rules, OIG added safe harbor protections under the Anti-Kickback Statute for certain coordinated care and value-based arrangements among clinicians, providers, and others. These rules (with exceptions) became effective January 19, 2021. We continue to evaluate what effect, if any, these rules will have on our business;
- federal civil and criminal false claims laws and civil monetary penalty laws, including the FCA, which prohibit, among other things, individuals or entities from knowingly presenting, or causing to be presented, false or fraudulent claims for payment to, or approval by Medicare, Medicaid, or other federal healthcare programs, knowingly making, using or causing to be made or used a false record or statement material to a false or fraudulent claim or an obligation to pay or transmit money to the federal government, or knowingly concealing or knowingly and improperly avoiding or decreasing or concealing an obligation to pay money to the federal government. Manufacturers can be held liable under the FCA even when they do not submit claims directly to government payors if they are deemed to “cause” the submission of false or fraudulent claims. The FCA also permits a private individual acting as a “whistleblower” to bring actions on behalf of the federal government alleging violations of the FCA and to share in any monetary recovery;
- the federal Health Insurance Portability and Accountability Act of 1996, or HIPAA, which created new federal criminal statutes that prohibit knowingly and willfully executing, or attempting to execute, a scheme to defraud any healthcare benefit program or obtain, by means of false or fraudulent pretenses, representations, or promises, any of the money or property owned by, or under the custody or control of, any healthcare benefit program, regardless of the payor (*e.g.*, public or private) and knowingly and willfully falsifying, concealing or covering up by any trick or device a material fact or making any materially false statements in connection with the delivery of, or payment for, healthcare benefits, items or services relating to healthcare matters. Similar to the federal Anti-Kickback Statute, a person or entity

can be found guilty of violating HIPAA without actual knowledge of the statute or specific intent to violate it;

- HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act of 2009, or HITECH, and their respective implementing regulations, which impose, among other things, requirements on certain covered healthcare providers, health plans, and healthcare clearinghouses as well as their respective business associates that perform services for them that involve the use, or disclosure of, individually identifiable health information, relating to the privacy, security and transmission of individually identifiable health information without appropriate authorization. HITECH also created new tiers of civil monetary penalties, amended HIPAA to make civil and criminal penalties directly applicable to business associates, 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 attorneys' fees and costs associated with pursuing federal civil actions; the federal Physician Payment Sunshine Act, created under the Patient Protection and Affordable Care Act, and its implementing regulations, which require manufacturers of drugs, devices, biologicals and medical supplies for which payment is available under Medicare, Medicaid or the Children's Health Insurance Program (with certain exceptions) to report annually to the HHS information related to payments or other transfers of value made to physicians (defined to include doctors, dentists, optometrists, podiatrists and chiropractors) and teaching hospitals, as well as ownership and investment interests held by physicians and their immediate family members. Effective January 1, 2022, these reporting obligations will extend to include transfers of value made to certain non-physician providers such as physician assistants and nurse practitioners;
- federal consumer protection and unfair competition laws, which broadly regulate marketplace activities and activities that potentially harm consumers; and
- analogous state and foreign laws and regulations, such as state anti-kickback and false claims laws, which may apply to sales or marketing arrangements and claims involving healthcare items or services reimbursed by non-governmental third-party payors, including private insurers, and may be broader in scope than their federal equivalents; state and foreign laws that require pharmaceutical companies to comply with the pharmaceutical industry's voluntary compliance guidelines and the relevant compliance guidance promulgated by the federal government or otherwise restrict payments that may be made to healthcare providers; state and foreign laws that require drug manufacturers to report information related to payments and other transfers of value to physicians and other healthcare providers or marketing expenditures; and state and foreign laws governing the privacy and security of individually identifiable health information and other personally identifiable information in certain circumstances, many of which differ from each other in significant ways and often are not preempted by HIPAA, thus complicating compliance efforts.

The distribution of pharmaceutical products is subject to additional requirements and regulations, including extensive record-keeping, licensing, storage and security requirements intended to prevent the unauthorized sale of pharmaceutical products.

The scope and enforcement of each of these laws is uncertain and subject to rapid change in the current environment of healthcare reform, especially in light of the lack of applicable precedent and regulations. Federal and state enforcement bodies have recently increased their scrutiny of interactions between healthcare companies and healthcare providers, which has led to a number of investigations, prosecutions, convictions and settlements in the healthcare industry. Ensuring business arrangements comply with applicable healthcare laws, as well as responding to possible investigations by government authorities, can be time- and resource-consuming and can divert a company's attention from the business.

The failure to comply with any of these laws or regulatory requirements subjects entities to possible legal or regulatory action. Depending on the circumstances, failure to meet applicable regulatory requirements can result in civil, criminal and administrative penalties, damages, fines, disgorgement, individual imprisonment, possible exclusion from participation in federal and state funded healthcare programs, contractual damages and the curtailment or restructuring of our operations, as well as additional reporting obligations and oversight if we become subject to a corporate integrity agreement or other agreement to resolve allegations of non-compliance with these

laws. Any action for violation of these laws, even if successfully defended, could cause a pharmaceutical manufacturer to incur significant legal expenses and divert management's attention from the operation of the business. Prohibitions or restrictions on sales or withdrawal of future marketed products could materially affect business in an adverse way.

Because of the breadth of these laws and the narrowness of the statutory exceptions and regulatory safe harbors available, it is possible that some of our business activities, or our arrangements with physicians, some of whom receive stock options as compensation, could be subject to challenge under one or more of such laws. If we or our employees, independent contractors, consultants, commercial partners and vendors violate these laws, we may be subject to investigations, enforcement actions and/or significant penalties. We have adopted a code of business conduct and ethics, but it is not always possible to identify and deter employee misconduct or business noncompliance, and the precautions we take to detect and prevent inappropriate conduct may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from governmental investigations or other actions or lawsuits stemming from a failure to be in compliance with such laws or regulations. Efforts to ensure that our business arrangements will comply with applicable healthcare laws may involve substantial costs. It is possible that governmental and enforcement authorities will conclude that our business practices may not comply with current or future statutes, regulations or case law interpreting applicable fraud and abuse or other healthcare laws and 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 civil, criminal and administrative penalties, damages, disgorgement, monetary fines, possible exclusion from participation in Medicare, Medicaid and other federal healthcare programs, contractual damages, reputational harm, diminished profits and future earnings, additional reporting requirements and/or oversight if we become subject to a corporate integrity agreement or similar agreement to resolve allegations of non-compliance with these laws, and curtailment of our operations, any of which could adversely affect our ability to operate our business and our results of operations.

Risks Related to Data and Privacy

Data collection is governed by restrictive regulations governing the use, processing, and cross-border transfer of personal information.

We are subject to stringent privacy and data protection requirements. The collection, use, storage, disclosure, transfer, or other processing of personal data regarding individuals in the European Economic Area, or EEA— including health data — is governed by the European Union-wide General Data Protection Regulation, or the GDPR, which became effective on May 25, 2018. The GDPR applies to any business, regardless of its location, that provides goods or services to residents in the EU or monitors the behavior of individuals within the European Union. The GDPR is wide ranging in scope and imposes stringent operational requirements for processors and controllers of personal data, including, for example, special protections for “sensitive information” which includes health and genetic information of data subjects residing in the EEA, expanded disclosures to individuals about how their personal data is to be used, limitations on retention of information, increased requirements pertaining to health data and pseudonymized (*i.e.*, key-coded) data, implementing safeguards to protect the security and confidentiality of personal data, mandatory data breach notification requirements and higher standards for controllers to demonstrate that they have obtained valid consent for certain data processing activities. The GDPR grants individuals the opportunity to object to the processing of their personal information, allows them to request deletion of personal information in certain circumstances, and provides the individual with an express right to seek legal remedies in the event the individual believes his or her rights have been violated. Further, the GDPR imposes strict rules on the transfer of personal data out of the European Union to the United States and other jurisdictions that have not been deemed to offer “adequate” privacy protections.

The GDPR provides that European Union Member States may make their own further laws and regulations in relation to the processing of genetic, biometric or health data, which could result in differences between Member States, limit our ability to use and share personal data or could cause our costs to increase, and harm our business and financial condition. Our clinical trial activity conducted within the member states of the European Union is regulated by the GDPR. In addition, we are subject to evolving and strict rules on the transfer of personal data out of the European Union to the United States. For example, evolution of laws governing the cross-border transfer of data, such as the invalidation of the EU–U.S. Privacy Shield, creates additional uncertainty around the legality and

mechanics of such transfers. Compliance with the GDPR will be a rigorous and time-intensive process that may increase our cost of doing business or require us to change our business practices, and despite those efforts, there is a risk that we may be subject to fines and penalties, litigation, and reputational harm in connection with any future European activities. We could be adversely affected if we fail to comply fully with all of these requirements. Failure to comply with European Union data protection laws may result in fines (for example, of up to €20,000,000 or up to 4% of the total worldwide annual turnover of the preceding financial year (whichever is higher) under the GDPR) and other administrative penalties, which may be onerous and adversely affect our business, financial condition, results of operations and prospects.

In addition, further to the United Kingdom's (UK) exit from the EU on January 31, 2020, the GDPR ceased to apply in the UK at the end of the transition period on December 31, 2020. However, as of January 1, 2021, the UK's European Union (Withdrawal) Act 2018 incorporated the GDPR (as it existed on December 31, 2020 but subject to certain UK specific amendments) into UK law (referred to as the 'UK GDPR'). The UK GDPR and the UK Data Protection Act 2018 set out the UK's data protection regime, which is independent from but aligned to the EU's data protection regime. Non-compliance with the UK GDPR may result in monetary penalties of up to £17.5 million or 4% of worldwide revenue, whichever is higher. The UK, however, is now regarded as a third country under the EU's GDPR which means that transfers of personal data from the EEA to the UK will be restricted unless an appropriate safeguard, as recognized by the EU's GDPR, has been put in place. Although, under the EU-UK Trade Cooperation Agreement it is lawful to transfer personal data between the UK and the EEA for a 6 month period following the end of the transition period, with a view to achieving an adequacy decision from the European Commission during that period. Like the EU GDPR, the UK GDPR restricts personal data transfers outside the UK to countries not regarded by the UK as providing adequate protection (this means that personal data transfers from the UK to the EEA remain free flowing).

This lack of clarity on future UK laws and regulations and their interaction with EU laws and regulations could add legal risk, uncertainty, complexity and cost to our handling of EU personal information and our privacy and data security compliance programs. It is possible that over time the UK Data Protection Act could become less aligned with the EU General Data Protection Regulation, or GDPR, which could require us to implement different compliance measures for the UK and the European Union and result in potentially enhanced compliance obligations for EU personal data.

Further, various jurisdictions around the world continue to propose new laws that regulate the privacy and/or security of certain types of personal data. Complying with these laws, if enacted, would require significant resources and leave us vulnerable to possible fines and penalties if we are unable to comply. The regulatory framework governing the collection, processing, storage, use and sharing of certain information is rapidly evolving and is likely to continue to be subject to uncertainty and varying interpretations. It is possible that these laws may be interpreted and applied in a manner that is inconsistent with our existing data management practices or the features of our services and platform capabilities. Any failure or perceived failure by us, or any third parties with which we do business, to comply with our posted privacy policies, evolving laws, rules and regulations, industry standards, or contractual obligations to which we or such third parties are or may become subject, may result in actions or other claims against us by governmental entities or private actors, the expenditure of substantial costs, time and other resources or the incurrence of significant fines, penalties or other liabilities. In addition, any such action, particularly to the extent we were found to be guilty of violations or otherwise liable for damages, would damage our reputation and adversely affect our business, financial condition and results of operations.

If our security measures are breached or unauthorized access to individually identifiable health information or other personally identifiable information is otherwise obtained, our reputation may be harmed, and we may incur significant liabilities.

Unauthorized access to, or security breaches of, our systems and databases could result in unauthorized access to data and information and loss, compromise or corruption of such data and information. The systems of Penn, any CMOs that we may engage in the future, and present and future CROs, contractors and consultants also could experience breaches of security leading to the exposure of confidential and sensitive information. Cyber incidents have been increasing in sophistication and frequency and can include third parties gaining access to employee or customer data using stolen or inferred credentials, computer malware, viruses, spamming, phishing attacks, ransomware, card skimming code, and other deliberate attacks and attempts to gain unauthorized access. Because the techniques used by computer programmers who may attempt to penetrate and sabotage our network security or

our website change frequently and may not be recognized until launched against a target, we may be unable to anticipate these techniques.

It is also possible that unauthorized access to customer data may be obtained through inadequate use of security controls by customers, suppliers or other vendors. While we are not currently aware of any impact that the SolarWinds supply chain attack had on our business, this is a recent event, and the scope of the attack is yet unknown. Therefore, there is residual risk that we may experience a security breach arising from the SolarWinds supply chain attack.

In the event of a security breach, our company could suffer loss of business, severe reputational damage adversely affecting investor confidence, regulatory investigations and orders, litigation, indemnity obligations, damages for contract breach, penalties for violation of applicable laws or regulations, significant costs for remediation and other liabilities. For example, the loss of preclinical study or clinical trial data from completed or future preclinical studies or clinical trials could result in delays in our regulatory approval efforts and significantly increase our costs to recover or reproduce the data. To the extent that any disruption or security breach were to result in a loss of, or damage to, our data or applications, or inappropriate disclosure of confidential or proprietary information, we could incur liability and the further development and commercialization of our product candidates could be delayed.

We have incurred and expect to incur significant expenses to prevent security breaches, including costs related to deploying additional personnel and protection technologies, training employees, and engaging third-party solution providers and consultants. Although we expend significant resources to create security protections that shield our customer data against potential theft and security breaches, such measures cannot provide absolute security. Moreover, as we outsource more of our information systems to vendors and rely more on cloud-based information systems, the related security risks will increase, and we will need to expend additional resources to protect our technology and information systems.

We have in the past experienced security incidents, and we may in the future experience other data security incidents or breaches affecting personally identifiable information or other confidential business information. For example, in 2019, we believe a phishing incident led to certain employee email accounts being accessed by an unauthorized third party. We initiated an investigation to determine whether further action was required under applicable law. The incident did not have a material impact on our business or financial condition. While we believe we responded appropriately, including implementing remedial measures with the goal of preventing similar such events in the future, there can be no assurance that we will be successful in these remedial and preventative measures or in successfully mitigating the effects of potential future incidents or cyber-attacks. We remain at risk for future breaches, including, without limitation, breaches that may occur as a result of third-party action, or employee, vendor or contractor error or malfeasance and other causes. If, in the future, we experience a data breach or security incident, we would be likely to experience harm to our reputation, financial performance, and customer and vendor relationships, and the possibility of litigation or regulatory investigations or actions by state and federal governmental authorities and non-U.S. authorities. Additionally, actual, potential or anticipated attacks may cause us to incur increasing costs, including costs to deploy additional personnel and protection technologies, train employees, and engage third-party experts and consultants. Although we maintain cyber liability insurance, we cannot be certain that our coverage will be adequate for liabilities actually incurred or that insurance will continue to be available to us on economically reasonable terms, or at all.

Interruptions in the availability of server systems or communications with internet or cloud-based services, or failure to maintain the security, confidentiality, accessibility or integrity of data stored on such systems, could harm our business.

We rely upon a variety of internet service providers, third-party web hosting facilities and cloud computing platform providers to support our business. Failure to maintain the security, confidentiality, accessibility or integrity of data stored on such systems could result in interruptions in our operations, damage our reputation in the market, increase our service costs, cause us to incur substantial costs, subject us to liability for damages and/or fines, and divert our resources from other tasks, any one of which could materially adversely affect our business, financial condition, results of operations and prospects. If our security measures or those of our third-party data center hosting facilities, cloud computing platform providers, or third-party service partners, are breached, and unauthorized access

is obtained to our data or our information technology systems, we may incur significant legal and financial exposure and liabilities.

We also do not have control over the operations of the facilities of our cloud service providers and our third-party web hosting providers, and they also may be vulnerable to damage or interruption from natural disasters, cybersecurity attacks, terrorist attacks, power outages and similar events or acts of misconduct. In addition, any changes in these providers' service levels may adversely affect our ability to meet our requirements and operate our business.

Risks Related to Ownership of Our Common Stock

Risks Related to Ownership Generally

Our principal stockholders and management own a significant percentage of our stock and will be able to exert significant control over matters subject to stockholder approval.

Our executive officers, directors, and 5% stockholders beneficially owned, in the aggregate, approximately 71% of our outstanding voting common stock, or 64% of our common stock, assuming all shares of non-voting common stock are converted into voting common stock in accordance with the terms of our amended and restated certificate of incorporation. Accordingly, these stockholders will have the ability to influence us through this ownership position and significantly affect the outcome of all matters requiring stockholder approval. For example, these stockholders may be able to significantly affect the outcome of elections of directors, amendments of our organizational documents, or approval of any merger, sale of assets, or other major corporate transaction. This may prevent or discourage unsolicited acquisition proposals or offers for our common stock that you may feel are in your best interest as one of our stockholders.

If we fail to establish and maintain proper and effective internal control over financial reporting, our operating results and our ability to operate our business could be harmed.

As a public company, we are required to maintain internal control over financial reporting and to report any material weaknesses in such internal controls. The Sarbanes-Oxley Act requires that we evaluate and determine the effectiveness of our internal control over financial reporting and, beginning with our second annual report following our initial public offering, provide a management report on internal control over financial reporting. However, while we remain an emerging growth company, we will not be required to include an attestation report on internal control over financial reporting issued by our independent registered public accounting firm.

Ensuring that we have adequate internal financial and accounting controls and procedures in place so that we can produce accurate financial statements on a timely basis is a costly and time-consuming effort that needs to be re-evaluated frequently. Our internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements in accordance with generally accepted accounting principles. We have begun the process of documenting, reviewing, and improving our internal controls and procedures for compliance with Section 404 of the Sarbanes-Oxley Act. We have begun recruiting additional finance and accounting personnel with certain skill sets that we need as a public company.

Implementing any appropriate changes to our internal controls may distract our officers and employees, entail substantial costs to modify our existing processes, and take significant time to complete. These changes may not, however, be effective in maintaining the adequacy of our internal controls, and any failure to maintain that adequacy, or consequent inability to produce accurate financial statements on a timely basis, could increase our operating costs and harm our business. In addition, investors' perceptions that our internal controls are inadequate or that we are unable to produce accurate financial statements on a timely basis may harm our stock price and make it more difficult for us to effectively market and sell our service to new and existing customers.

The dual class structure of our common stock may limit your ability to influence corporate matters and may limit your visibility with respect to certain transactions.

The dual class structure of our common stock may limit your ability to influence corporate matters. Holders of our common stock are entitled to one vote per share, while holders of our non-voting common stock are not entitled to any votes. Nonetheless, each share of our non-voting common stock may be converted at any time into one share of our common stock at the option of its holder by providing written notice to us, subject to the limitations provided for in our amended and restated certificate of incorporation. Entities affiliated with or managed by Baker Brothers Life Sciences, L.P. and Adage Capital Partners, LP hold an aggregate of 4,458,004 shares of our non-voting common stock pursuant to our Third Amended and Restated Certificate of Incorporation. At any time, upon written notice, these entities could convert a portion of these shares of non-voting common stock into up to an aggregate of 19% of our shares of common stock. Upon 61 days' prior written notice, these entities could convert any or all of their respective shares of non-voting common stock into shares of common stock. Consequently, if holders of our non-voting common stock exercise their option to make this conversion, this will have the effect of increasing the relative voting power of those prior holders of our non-voting common stock, and correspondingly decreasing the voting power of the holders of our common stock, which may limit your ability to influence corporate matters. Additionally, stockholders who hold, in the aggregate, more than 10% of our common stock and non-voting common stock, but 10% or less of our common stock, and are not otherwise a company insider, may not be required to report changes in their ownership due to transactions in our non-voting common stock pursuant to Section 16(a) of the Exchange Act, and may not be subject to the short-swing profit provisions of Section 16(b) of the Exchange Act.

Sales of a substantial number of shares of our common stock by our existing stockholders in the public market could cause our stock price to fall.

Sales of a substantial number of shares of our common stock in the public market could occur at any time. These sales, or the perception in the market that holders of a large number of shares intend to sell shares, could reduce the market price of our common stock. Certain holders of our common stock have rights, subject to conditions, to require us to file registration statements covering their shares or to include their shares in registration statements that we may file for ourselves or other stockholders. Registration of these shares under the Securities Act would result in the shares becoming freely tradable without restriction under the Securities Act, except for shares held by affiliates, as defined in Rule 144 under the Securities Act. Any sales of securities by these stockholders could have a material adverse effect on the trading price of our common stock.

On November 10, 2020, we filed a registration statement on Form S-3 (File No. 333-250006) with the SEC, which was declared effective on November 18, 2020 (the "Shelf Registration Statement"), in relation to the registration of common stock, preferred stock, debt securities, warrants and/or units of any combination thereof for the purposes of selling, from time to time, our common stock, debt securities or other equity securities in one or more offerings. We also simultaneously entered into a Sales Agreement (the "Sales Agreement") with Cowen and Company, LLC, (the "Sales Agent"), to provide for the offering, issuance and sale of up to an aggregate amount of \$75.0 million of our common stock from time to time in "at-the-market" offerings under the Shelf Registration Statement and subject to the limitations thereof. The Company will pay to the Sales Agent cash commissions of 3.0 percent of the aggregate gross proceeds of sales of common stock under the Sales Agreement. Sales of common stock, debt securities or other equity securities by us may represent a significant percentage of our common stock currently outstanding. If we sell, or the market perceives that we intend to sell, substantial amounts of our common stock under the Shelf Registration Statement or otherwise, the market price of our common stock could decline significantly.

We also filed a registration statement on Form S-8 registering the issuance of 4.5 million shares of common stock issued or reserved for future issuance under our equity compensation plans. Shares registered under this registration statement on Form S-8 can be freely sold in the public market upon issuance and once vested, subject to volume limitations applicable to affiliates and the lock-up agreements described above. If any of these additional shares are sold, or if it is perceived that they will be sold, in the public market, the market price of our common stock could decline.

In addition, certain of our employees, executive officers, and directors may enter into Rule 10b5-1 trading plans providing for sales of shares of our common stock from time to time. Under a Rule 10b5-1 trading plan, a broker executes trades pursuant to parameters established by the employee, director, or officer when entering into the plan, without further direction from the employee, officer, or director. A Rule 10b5-1 trading plan may be amended or terminated in some circumstances. Our employees, executive officers, and directors also may buy or sell additional shares outside of a Rule 10b5-1 trading plan when they are not in possession of material, nonpublic information.

Risks Related to our Charter and Bylaws

Anti-takeover provisions under our charter documents and Delaware law could delay or prevent a change of control which could limit the market price of our common stock and may prevent or frustrate attempts by our stockholders to replace or remove our current management.

Our amended and restated certificate of incorporation and amended and restated bylaws contain provisions that could delay or prevent a change of control of our company or changes in our board of directors that our stockholders might consider favorable. Some of these provisions include:

- a board of directors divided into three classes serving staggered three-year terms, such that not all members of the board will be elected at one time;
- a prohibition on stockholder action through written consent, which requires that all stockholder actions be taken at a meeting of our stockholders;
- a requirement that special meetings of stockholders be called only by the chairman of the board of directors, the chief executive officer, or by a majority of the total number of authorized directors;
- advance notice requirements for stockholder proposals and nominations for election to our board of directors;
- a requirement that no member of our board of directors may be removed from office by our stockholders except for cause and, in addition to any other vote required by law, upon the approval of the holders of not less than 75% of the votes that all our stockholders would be entitled to cast in an annual election of directors;
- a requirement of approval of not less than 75% of all outstanding shares of our voting stock to amend any bylaws by stockholder action or to amend specific provisions of our certificate of incorporation; and
- the authority of the board of directors to issue preferred stock on terms determined by the board of directors without stockholder approval and which preferred stock may include rights superior to the rights of the holders of common stock.

In addition, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporate Law, which may prohibit certain business combinations with stockholders owning 15% or more of our outstanding voting stock. These anti-takeover provisions and other provisions in our amended and restated certificate of incorporation and amended and restated bylaws could make it more difficult for stockholders or potential acquirors to obtain control of our board of directors or initiate actions that are opposed by the then-current board of directors and could also delay or impede a merger, tender offer or proxy contest involving our company. These provisions could also discourage proxy contests and make it more difficult for you and other stockholders to elect directors of your choosing or cause us to take other corporate actions you desire. Any delay or prevention of a change of control transaction or changes in our board of directors could cause the market price of our common stock to decline.

Our amended and restated bylaws designate certain courts as the sole and exclusive forum for certain types of actions and proceedings that may be initiated by our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us or our directors, officers, or employees.

Pursuant to our amended and restated bylaws, unless we consent in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware (or, if the Chancery Court does not have jurisdiction, the federal district court for the District of Delaware or other state courts of the State of Delaware) will be the sole and exclusive forum for state law claims for: (i) any derivative action or proceeding brought on our behalf; (ii) any action asserting a claim of breach of a fiduciary duty or other wrongdoing by any of our directors, officers, employees or agents to us or our stockholders; (iii) any action asserting a claim against us arising pursuant to any provision of the Delaware General Corporation Law or our certificate of incorporation or bylaws; (iv) any action to interpret, apply, enforce or determine the validity of our certificate of incorporation or bylaws; or (v) any action asserting a claim governed by the internal affairs doctrine (the Delaware Forum Provision). The Delaware Forum Provision will not apply to any causes of action arising under the Securities Act of 1933, as amended (the Securities Act) or the Securities Exchange Act of 1934. In addition, our amended and restated bylaws provide that any person or entity purchasing or otherwise acquiring any interest in shares of our common stock is deemed to have notice of and consented to the foregoing provisions. We recognize that the forum selection clause in our bylaws may impose additional litigation costs on stockholders in pursuing any such claims, particularly if the stockholders do not reside in or near the State of Delaware. Additionally, the forum selection clauses in our amended and restated bylaws may limit our stockholders' ability to bring a claim in a forum that they find favorable for disputes with us or our directors, officers or employees, which may discourage such lawsuits against us and our directors, officers and employees even though an action, if successful, might benefit our stockholders. The Court of Chancery of the State of Delaware may also reach different judgments or results than would other courts, including courts where a stockholder considering an action may be located or would otherwise choose to bring the action, and such judgments may be more or less favorable to us than our stockholders. Alternatively, if a court were to find the choice of forum provision contained in our amended and restated bylaws to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions, which could materially adversely affect our business, financial condition and operating results.

Risks Related to Tax

Changes in tax laws could adversely affect our business and financial condition.

The rules dealing with U.S. federal, state, and local income taxation are constantly under review by persons involved in the legislative process and by the Internal Revenue Service and the U.S. Treasury Department. Changes to tax laws (which changes may have retroactive application) could adversely affect us or holders of our common stock. In recent years, many such changes have been made and changes are likely to continue to occur in the future. Future changes in tax laws could have a material adverse effect on our business, cash flow, financial condition or results of operations. Prospective investors in our common stock should consult with their legal and tax advisors with respect to potential changes in tax laws and the tax consequences of investing in or holding our common stock.

Our ability to utilize our net operating losses and certain other tax attributes to offset future taxable income may be subject to certain limitations.

As of December 31, 2020, we had U.S. federal, state and local net operating loss carryforwards of \$45.6 million, \$47.7 million and \$38.6 million, respectively. \$0.3 million of the federal amounts expire in 2037. The state net operating losses begin to expire in 2037 and the local net operating losses begin to expire in 2039. Approximately \$45.3 million of the federal net operating losses can be carried forward indefinitely. Certain net operating loss carryforwards could expire unused and be unavailable to offset future taxable income. In addition, in general, under Sections 382 and 383 of the Internal Revenue Code of 1986, as amended, or the Code, and corresponding provisions of state law, a corporation that undergoes an "ownership change" is subject to limitations on its ability to utilize its pre-change net operating loss carryforwards or tax credits, or NOLs or credits, to offset future taxable income or taxes. For these purposes, an ownership change generally occurs where the aggregate stock ownership of one or more stockholders or groups of stockholders who owns at least 5% of a corporation's stock increases its ownership by more than 50 percentage points over its lowest ownership percentage within a specified testing period. Our existing NOLs or credits may be subject to limitations arising from previous ownership changes.

and if we undergo an ownership change, our ability to utilize NOLs or credits could be further limited by Sections 382 and 383 of the Code. In addition, future changes in our stock ownership, many of which are outside of our control, could result in an ownership change under Sections 382 and 383 of the Code. Our NOLs or credits may also be impaired under state law. Accordingly, we may not be able to utilize a material portion of our NOLs or credits. Furthermore, our ability to utilize our NOLs or credits is conditioned upon our attaining profitability and generating U.S. federal and state taxable income. As described above under “—Risks Related to Our Financial Condition and Capital Requirements”, we have incurred significant net losses since our inception and anticipate that we will continue to incur significant losses for the foreseeable future; and therefore, we do not know whether or when we will generate the U.S. federal or state taxable income necessary to utilize our NOLs or credits. Under current law, U.S. federal net operating loss carryforwards generated in taxable years beginning after December 31, 2017 will not be subject to expiration. However, any such net operating loss carryforwards may only offset 80% of our annual taxable income in taxable years beginning after December 31, 2020.

General Risk Factors

The price of our stock may be volatile, and you could lose all or part of your investment.

The trading price of our common stock is likely to be highly volatile and could be subject to wide fluctuations in response to various factors, some of which are beyond our control, including limited trading volume. In addition to the factors discussed in this “Risk Factors” section, these factors include:

- the commencement, enrollment or results of our planned preclinical studies or clinical trials of our product candidates or any preclinical studies or future clinical trials we may conduct, or changes in the development status of our product candidates;
- our decision to initiate a preclinical study or clinical trial, not to initiate a preclinical study or clinical trial or to terminate an existing preclinical study or clinical trial;
- adverse results or delays in preclinical studies or clinical trials of our product candidates;
- any delay in our regulatory filings for our product candidates and any adverse development or perceived adverse development with respect to the applicable regulatory authority’s review of such filings, including, without limitation, the FDA’s issuance of a “refusal to file” letter or a request for additional information;
- our failure to commercialize our product candidates;
- adverse regulatory decisions, including failure to receive regulatory approval of our product candidates;
- changes in laws or regulations applicable to our product candidates, including, but not limited to, clinical trial requirements for approvals;
- adverse developments concerning our manufacturers or suppliers;
- our inability to obtain adequate product supply for any licensed product or inability to do so at acceptable prices;
- our inability to establish collaborations, if needed;
- additions or departures of key scientific or management personnel;
- unanticipated serious safety concerns related to the use of our product candidates;
- introduction of new products or services offered by us or our competitors;
- announcements of significant acquisitions, strategic partnerships, joint ventures or capital commitments by us or our competitors;
- our ability to effectively manage our growth;
- the size and growth of our initial target markets;
- our ability to successfully treat additional types of B cell-mediated autoimmune diseases;

- actual or anticipated variations in annual or quarterly operating results;
- our cash position;
- our failure to meet the estimates and projections of the investment community or that we may otherwise provide to the public;
- publication of research reports about us or our industry or positive or negative recommendations or withdrawal of research coverage by securities analysts;
- changes in the market valuations of similar companies;
- overall performance of the equity markets;
- sales of our common stock by us or our stockholders in the future;
- trading volume of our common stock;
- changes in accounting practices;
- ineffectiveness of our internal controls;
- disputes or other developments relating to proprietary rights, including patents, litigation matters and our ability to obtain patent protection for our technologies;
- significant lawsuits, including patent or stockholder litigation;
- general political and economic conditions;
- global health concerns, such as the COVID-19 pandemic; and
- other events or factors, many of which are beyond our control.

In addition, the stock market in general, and The Nasdaq Global Select Market and biopharmaceutical companies in particular, have experienced extreme price and volume fluctuations that have often been unrelated or disproportionate to the operating performance of these companies. Broad market and industry factors may negatively affect the market price of our common stock, regardless of our actual operating performance. In the past, securities class action litigation has often been instituted against companies following periods of volatility in the market price of a company's securities. This type of litigation, if instituted, could result in substantial costs and a diversion of management's attention and resources, which would harm our business, operating results or financial condition.

We do not intend to pay dividends on our common stock, so any returns will be limited to the value of our stock.

We currently anticipate that we will retain future earnings for the development, operation and expansion of our business and do not anticipate declaring or paying any cash dividends for the foreseeable future. Any return to stockholders will therefore be limited to the appreciation of their stock.

We are an emerging growth company and a "smaller reporting company," and we cannot be certain if the reduced reporting requirements applicable to emerging growth companies and smaller reporting companies will make our common stock less attractive to investors.

We are an emerging growth company, as defined in the Jumpstart Our Business Startups Act, or JOBS Act. For as long as we continue to be an emerging growth company, we may take advantage of exemptions from various reporting requirements that are applicable to other public companies that are not emerging growth companies, including not being required to comply with the auditor attestation requirements of Section 404 of the Sarbanes-Oxley Act of 2002, as amended, or the Sarbanes-Oxley Act, reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements and exemptions from the requirements of holding nonbinding advisory votes on executive compensation and stockholder approval of any golden parachute payments not previously approved. We could be an emerging growth company for up to five years following the date of completion of our initial public offering, although circumstances could cause us to lose that status earlier. We will remain an emerging growth company until the earlier of (1) the last day of the fiscal year (a) following the fifth

anniversary of the completion of our initial public offering, (b) in which we have total annual gross revenue of at least \$1.07 billion or (c) in which we are deemed to be a large accelerated filer, which requires the market value of our common stock that is held by non-affiliates to exceed \$700 million as of the prior June 30th, and (2) the date on which we have issued more than \$1 billion in non-convertible debt during the prior three-year period.

Under the JOBS Act, emerging growth companies can also delay adopting new or revised accounting standards until such time as those standards apply to private companies. We have elected to use this extended transition period for complying with new or revised accounting standards that have different effective dates for public and private companies until the earlier of the date we (i) are no longer an emerging growth company or (ii) affirmatively and irrevocably opt out of the extended transition period provided in the JOBS Act. As a result, we are not subject to the same new or revised accounting standards as other public companies that are not emerging growth companies and our financial statements may not be comparable to other public companies that comply with new or revised accounting pronouncements as of public company effective dates.

We are also a “smaller reporting company,” as defined in Rule 12b-2 under the Securities Exchange Act of 1934, as amended. We would cease to be a smaller reporting company if we have a public float in excess of \$250 million, or have annual revenues in excess of \$100 million and a public float in excess of \$700 million, determined on an annual basis. Consequently, even after we no longer qualify as an emerging growth company, we may still qualify as a “smaller reporting company” which would allow us to take advantage of many of the same exemptions from disclosure requirements including not being required to comply with the auditor attestation requirements of Section 404 of the Sarbanes-Oxley Act and reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements. We cannot predict if investors will find our common stock less attractive because we may rely on these exemptions. If some investors find our common stock less attractive as a result, there may be a less active trading market for our common stock and our stock price may be more volatile.

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

We may seek additional capital through a combination of public and private equity offerings, debt financings, strategic partnerships and alliances and licensing arrangements. To the extent that we raise additional capital through the sale of equity or convertible debt securities, your ownership interest will be diluted, and the terms may include liquidation or other preferences that adversely affect your rights as a stockholder. The incurrence of indebtedness would result in increased fixed payment obligations and could involve certain restrictive covenants, such as limitations on our ability to incur additional debt, limitations on our ability to acquire or license intellectual property rights and other operating restrictions that could adversely impact our ability to conduct our business. If we raise additional funds through strategic partnerships and alliances and licensing arrangements with third parties, we may have to relinquish valuable rights to our technologies or product candidates or grant licenses on terms unfavorable to us.

If securities or industry analysts do not publish research or publish inaccurate or unfavorable research about our business, our stock price and trading volume could decline.

The trading market for our common stock depends in part on the research and reports that securities or industry analysts publish about us or our business. In the event that one or more of the analysts who covers us downgrades our stock or publishes inaccurate or unfavorable research about our business, our stock price may decline. If one or more of these analysts ceases coverage of our company or fails to publish reports on us regularly, demand for our stock could decrease, which might cause our stock price and trading volume to decline.

Item 1B. Unresolved Staff Comments.

None.

Item 2. Properties.

Our corporate headquarters are located in Philadelphia, PA, where we lease 7,672 square feet of office, research and development space subject to a lease agreement that is in effect through 2022. We expect to expand to a new space in 2022 that will both be adequate for near-term needs in addition to providing additional space to grow. We feel that suitable additional research and development, laboratory and manufacturing space should be available in the region on commercially reasonable terms.

Item 3. Legal Proceedings.

From time to time, we may be involved in lawsuits, claims, investigations and proceedings, consisting of intellectual property, commercial, employment and other matters which arise in the ordinary course of business. While the outcome of any such proceedings cannot be predicted with certainty, as of December 31, 2020, we were not party to any legal proceedings that we would expect to have a material adverse impact on our financial position, results of operations or cash flow.

Item 4. Mine Safety Disclosures.

Not applicable.

PART II

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities.

Our common stock trades on The Nasdaq Global Select Market under the symbol "CABA". Trading of our common stock commenced on October 25, 2019, in connection with our initial public offering, or IPO. Prior to that time, there was no established public trading market for our common stock.

Stockholders

As of March 10, 2021, we had approximately 14 holders of record of our common stock. The actual number of holders of our common stock is greater than this number of record holders and includes stockholders who are beneficial owners, but whose shares are held in street name by brokers or held by other nominees. The number of holders of record also does not include stockholders whose shares may be held in trust by other entities.

Dividend Policy

We have never declared or paid any cash dividends on our common stock. We currently intend to retain all available funds and any future earnings, if any, to fund the development and growth of our business. We do not expect to pay any cash dividends in the foreseeable future. Any future determination to pay dividends will be made at the discretion of our board of directors and will depend on various factors, including applicable laws, our results of operations, financial condition, future prospects, then applicable contractual restrictions and any other factors deemed relevant by our board of directors. Investors should not purchase our common stock with the expectation of receiving cash dividends.

Equity Compensation Plan

The information required by Item 5 of Form 10-K regarding equity compensation plans is incorporated herein by reference to Item 12 of Part III of this Annual Report on Form 10-K.

Issuer Purchases of Equity Securities

We did not purchase any of our equity securities during the period covered by this Annual Report on Form 10-K.

Recent Sales of Unregistered Securities

None.

Use of Proceeds from the Initial Public Offering

On October 29, 2019, we closed our initial public offering, or IPO, in which we issued and sold 7,275,501 shares of common stock at a public offering price of \$11.00 per share, including 475,501 shares of common stock at a price of \$11.00 per share pursuant to the exercise of the underwriters' over-allotment option. All of the shares of common stock issued and sold in our initial public offering were registered under the Securities Act pursuant to a registration statement on Form S-1 (Registration No. 333-234017), which was declared effective by the SEC on October 24, 2019. Morgan Stanley & Co. LLC, Cowen and Company and Evercore Group L.L.C. acted as joint book-running managers for the offering.

The aggregate net proceeds to us from the public offering, inclusive of the over-allotment exercise, were approximately \$71.0 million, after deducting underwriting discounts and commissions and other offering expenses payable by us of approximately \$3.4 million. No offering expenses were paid directly or indirectly to any of our directors or officers (or their associates) or persons owning 10% or more of any class of our equity securities or to any other affiliates.

Information related to use of proceeds from registered securities is incorporated herein by reference to the "Use of Proceeds" section of the Company's final prospectus related to the IPO. The amounts and timing of our

actual expenditures may vary significantly depending on numerous factors, including the progress of our research and development, the status of and results from non-clinical studies or clinical trials we may commence in the future, as well as any collaborations that we may enter into with third parties for our product candidates or strategic opportunities that become available to us, and any unforeseen cash needs. As a result, our management will retain broad discretion over the allocation of the net proceeds from this offering. There has been no material change in the planned use of proceeds from our IPO as described in our final prospectus. As of December 31, 2020, we have not used any of the net proceeds from our initial public offering.

Item 6. Selected Financial Data.

Reserved.

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

You should read the following discussion and analysis of our financial condition and results of operations together with the section entitled "Selected Financial Information" and our financial statements and related notes appearing elsewhere in this Annual Report on Form 10-K, or this Annual Report. Some of the information contained in this discussion and analysis or set forth elsewhere in this Annual Report, including information with respect to our plans and strategy for our business and related financing, includes forward-looking statements that involve risks and uncertainties. As a result of many factors, including those factors set forth in the section entitled "Risk Factors," our actual results could differ materially from the results described in or implied by the forward-looking statements contained in the following discussion and analysis. You should carefully read the section entitled "Risk Factors" to gain an understanding of the important factors that could cause actual results to differ materially from our forward-looking statements. Please also see the section entitled "Special Note Regarding Forward-Looking Statements." 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.

Overview

We are a clinical-stage biotechnology company focused on the discovery and development of engineered T cell therapies, and exploring their potential to provide a deep and durable, perhaps curative, treatment, for patients with B cell-mediated autoimmune diseases. Our proprietary technology utilizes Chimeric AutoAntibody Receptor, or CAAR, T cells that are designed to selectively bind and eliminate only specific B cells that produce disease-causing autoantibodies, or pathogenic B cells, while sparing normal B cells. Our lead CAAR T cell product candidate was designed based on the clinically validated and commercially approved Chimeric Antigen Receptor, or CAR, T cell technology that is marketed for the treatment of B cell cancers. By harnessing the power of targeted cell therapy, we believe our CAAR T product candidates have the potential to provide responses that may be a safer and more effective option than current treatments. We believe our technology, in combination with our proprietary Cabaletta Approach for selective B cell Ablation platform, called our CABA platform, has applicability across over two dozen B cell-mediated autoimmune diseases that we have identified, evaluated and prioritized. In order to accelerate product development for our lead program and to access a proven cell therapy manufacturing platform, we have entered into a collaboration with the University of Pennsylvania, or Penn. We hold multiple agreements with Penn to develop CAAR T cell therapies for the treatment of these diseases. Our goal is to leverage our team's expertise in autoimmunity and engineered T cell therapy and our collaboration with Penn to rapidly discover and develop our portfolio of CAAR T product candidates. Our initial focus is mucosal pemphigus vulgaris, or mPV, which is an autoimmune blistering disease. We submitted an Investigational New Drug, or IND, application for our lead product candidate, DSG3-CAART, to the U.S. Food and Drug Administration, or the FDA, in August 2019 and our IND was cleared in September 2019. The FDA granted DSG3-CAART orphan drug designation for the treatment of PV in January 2020, and fast track designation for improving healing of mucosal blisters in patients with mucosal pemphigus vulgaris, or mPV, in May 2020. Our lead product candidate, DSG3-CAART, designed to treat patients with mPV, is currently enrolling patients for a Phase 1 trial, or the DesCAARTes™ trial. In December 2020, we announced that the first patient had been dosed in the DesCAARTes™ trial. We expect to report the acute safety data from the first cohort of patients in the DesCAARTes™ trial in the first half of 2021, with additional topline data from any completed dose cohorts throughout the second half of 2021. Our lead preclinical product candidate is designed for the treatment of muscle-specific kinase myasthenia gravis, or MuSK MG, and is currently in IND enabling studies, with an IND submission expected in the second half of 2021. We are also advancing additional product candidates currently in discovery-stage or preclinical development for the treatment of mucocutaneous PV, or mCPV, and Hemophilia A with Factor VIII, or FVIII, alloantibodies in addition to three undisclosed targets.

We were incorporated in April 2017. In August 2018, we entered into multiple agreements with Penn to develop the CAAR T technology to treat B cell-mediated autoimmune diseases. Our operations to date have been financed primarily by net proceeds of \$86.4 million from the sale of convertible notes and convertible preferred stock and net proceeds of \$71.0 million from the sale of common stock in our initial public offering, or IPO, in October 2019. As of December 31, 2020, we had \$108.7 million in cash and cash equivalents and investments.

Amended and Restated License Agreement with the Trustees of the University of Pennsylvania and the Children's Hospital of Philadelphia

In August 2018, we entered into a license agreement with Penn, which was amended and restated in July 2019 to include the Children's Hospital of Philadelphia, or CHOP, collectively, the Institutions, and collectively with such amendment, as amended in May 2020, the License Agreement, pursuant to which we obtained (a) a non-exclusive, non-sublicensable, worldwide research license to make, have made and use products in two subfields of use, (b) effective as of October 2018, an exclusive, worldwide, royalty-bearing license, with the right to sublicense, under certain of the Institutions' intellectual property to make, use, sell, offer for sale and import products in the same two subfields of use, and (c) effective as of October 2018, a non-exclusive, worldwide, royalty-bearing license, with limited rights to sublicense, under certain of Penn's know-how to make, have made, use, sell, offer for sale, import and have imported products in the same two subfields of use. Our rights are subject to the rights of the U.S. government and certain rights retained by the Institutions.

Unless earlier terminated, the License Agreement expires on the expiration or abandonment or other termination of the last valid claim in Penn's intellectual property licensed by us. We may terminate the License Agreement at any time for convenience upon 60 days written notice. In the event of an uncured, material breach, Penn may terminate the License Agreement upon 60 days written notice.

Sponsored Research Agreements

We have two sponsored research agreements, or SRAs, with Penn for the laboratories of Drs. Payne and Milone, who are also our scientific co-founders and members of our scientific advisory board. In May 2020, the agreement with Dr. Payne, or the Payne SRA, was expanded to include CAAR design and optimization efforts in three additional B cell-mediated autoimmune diseases. In August 2020, the Payne SRA was further amended to extend the term of the original research plan. Under the amended agreements, we are committed to funding a defined research plan through February 2023. The total estimated cost of the agreements is \$11.8 million, which satisfies the \$2.0 million annual obligation under the License Agreement. As of December 31, 2020, \$7.1 million of cost has been incurred pursuant to these agreements.

Master Translational Research Services Agreement

In October 2018, we entered into a Master Translational Services Agreement with Penn, or the Services Agreement, pursuant to which Penn agreed to perform certain services related to the research and development of the technology licensed to us under the License Agreement, as well as certain clinical, regulatory and manufacturing services. The Services Agreement will expire on the later of (i) October 19, 2021 or (ii) completion of the services for which we have engaged Penn under the Services Agreement. Either party may terminate this agreement with or without cause upon a certain number of days' prior written notice. The services encompassed by the Services Agreement are performed by different organizations at Penn pursuant to certain addenda to the Services Agreement, including the Center for Advanced Retinal and Ocular Therapeutics, or CAROT, Addendum, as amended in May 2020, and the CVPF Addendum.

Components of Operating Results

Revenue

To date, we have not generated any revenue from product sales and do not expect to generate any revenue from the sales of products for several years, if at all. If our development efforts for our current or future product candidates are successful and result in marketing approval, we may generate revenue in the future from product sales. We cannot predict if, when or to what extent we will generate revenue from the commercialization and sale of our product candidates. We may never succeed in obtaining regulatory approval for any of our product candidates.

We may also in the future enter into license or collaboration agreements for our product candidates or intellectual property, and we may generate revenue in the future from payments as a result of such license or collaboration agreements.

Operating Expenses

Research and Development

Our research and development expenses include:

- personnel costs, which include salaries, benefits and stock-based compensation expense;
- expenses incurred under agreements with consultants and third-party contract organizations that conduct research and development activities on our behalf;
- costs related to sponsored research service agreements;
- costs related to production of preclinical and clinical materials, including fees paid to contract manufacturers;
- licensing fees for intellectual property and know-how;
- laboratory and vendor expenses related to the execution of preclinical studies and ongoing and planned clinical trials; and
- laboratory supplies and equipment used for internal research and development activities and related depreciation expense.

We have not reported program costs since inception because historically we have not tracked or recorded our research and development expenses on a pre-clinical program-by-program basis. We use our personnel and infrastructure resources across the breadth of our research and development activities, which are directed toward identifying and developing product candidates.

We expense all research and development costs in the periods in which they are incurred. Costs for certain research and development activities are recognized based on an evaluation of the progress to completion of specific tasks using information and data provided to us by our vendors and third-party service providers.

We expect our research and development expenses to increase substantially for the foreseeable future as we continue to invest in research and development activities related to developing our product candidates, including investments in manufacturing, as our programs advance and we conduct clinical trials. The process of conducting the necessary clinical research to obtain regulatory approval is costly and time-consuming, and the successful development of our product candidates is highly uncertain. As a result, we are unable to determine the duration and completion costs of our research and development projects or when and to what extent we will generate revenue from the commercialization and sale of any of our product candidates.

Because of the numerous risks and uncertainties associated with product development, we cannot determine with certainty the duration and completion costs of the current or future preclinical studies and clinical trials or if, when, or to what extent we will generate revenues from the commercialization and sale of our product candidates. We may never succeed in achieving regulatory approval for our product candidates. The duration, costs and timing of preclinical studies and clinical trials and development of our product candidates will depend on a variety of factors, including:

- successful completion of preclinical studies and IND-enabling studies;
- development of chemistry, manufacturing and controls, or CMC, processes and procedures for purposes of IND applications;
- successful patient enrollment in, and the initiation and completion of, clinical trials;
- the impact of any business interruptions to our operations, including the timing and enrollment of patients in our ongoing and planned clinical trials, or to those of our clinical sites, manufacturers, suppliers, or other vendors resulting from the COVID-19 pandemic or similar public health crisis;
- receipt of regulatory approvals from applicable regulatory authorities;
- establishing commercial manufacturing capabilities or arrangements with third-party manufacturers;

- obtaining and maintaining patent and trade secret protection and non-patent exclusivity;
- launching commercial sales of our product candidates, if and when approved, whether alone or in collaboration with others;
- acceptance of our product candidates, if and when approved, by patients, the medical community and third-party payors;
- effectively competing with other therapies and treatment options;
- a continued acceptable safety and efficacy profile following approval;
- enforcing and defending intellectual property and proprietary rights and claims; and
- achieving desirable medicinal properties for the intended indications.

We may never succeed in achieving regulatory approval for any of our product candidates. We may obtain unexpected results from our preclinical studies and clinical trials. We may elect to discontinue, delay or modify clinical trials of some product candidates or focus on others. A change in the outcome of any of these factors could mean a significant change in the costs and timing associated with the development of our current and future preclinical and clinical product candidates. For example, if the FDA or another regulatory authority, were to require us to conduct clinical trials beyond those that we currently anticipate will be required for the completion of clinical development, or if we experience significant delays in execution of or enrollment in any of our preclinical studies or clinical trials, we could be required to expend significant additional financial resources and time on the completion of preclinical and clinical development. We expect our research and development expenses to increase for the foreseeable future as we continue the development of product candidates.

General and Administrative Expenses

Our general and administrative expenses consist primarily of personnel costs, costs related to maintenance and filing of intellectual property, depreciation expense and other expenses for outside professional services, including legal, human resources, audit and accounting services. Personnel costs consist of salaries, benefits and stock-based compensation expense. We expect our general and administrative expenses to increase over the next several years to support our continued research and development activities, manufacturing activities, increased costs of operating as a public company and the potential commercialization of our product candidates. We anticipate our general and administrative costs will increase with respect to the hiring of additional personnel, developing commercial infrastructure, fees to outside consultants, lawyers and accountants, and increased costs associated with being a public company such as expenses related to services associated with maintaining compliance with Nasdaq listing rules and SEC requirements, insurance and investor relations costs.

Other Income

Other income consists of interest earned on our cash equivalents, amortization of bond discount or premium and investment gains and losses realized during the period.

Results of Operations for the years ended December 31, 2020 and 2019

The following sets forth our results of operations:

	Year Ended December 31,		Change
	2020	2019	
	(in thousands)		
Statements of Operations Data:			
Operating expenses:			
Research and development	\$ 21,376	\$ 11,671	\$ 9,705
General and administrative	12,457	7,012	5,445
Total operating expenses	33,833	18,683	15,150
Loss from operations	(33,833)	(18,683)	(15,150)
Other income:			
Interest income	494	1,740	(1,246)
Net loss	\$ (33,339)	\$ (16,943)	\$ (16,396)

Research and Development Expenses

Research and development expenses were \$21.4 million for the year ended December 31, 2020 as compared to \$11.7 million for the year ended December 31, 2019. The table below summarizes our research and development expenses:

	Year Ended December 31,		Change
	2020	2019	
	(in thousands)		
Sponsored research activities	\$ 3,062	\$ 2,228	\$ 834
License of intellectual property and subscription fee	143	268	(125)
Manufacturing of preclinical and clinical supplies	4,652	2,382	2,270
Clinical trials	1,202	441	761
Personnel	7,827	4,006	3,821
Development services	4,350	2,146	2,204
Other	140	200	(60)
	\$ 21,376	\$ 11,671	\$ 9,705

Specific changes in our research and development expenses year over year include a:

- \$3.8 million increase in personnel costs primarily driven by an increase in headcount to support overall growth including an increase of \$0.7 million in stock-based compensation expense;
- \$2.3 million increase in manufacturing costs primarily due to vector manufacturing and cell processing capabilities and related activities
- \$2.2 million increase in costs under our development services from increased outsourced preclinical research activities and lab related expenses;
- \$0.8 million increase in costs under our sponsored research agreements primarily due to an expanded scope of research;
- \$0.8 million increase in clinical trial costs for the DesCAARTes™ trial, including outsourced costs and investigator payments to clinical trial sites; and
- \$0.2 million decrease in license of intellectual property and subscription fees and other due primarily to a non-refundable payment made to Penn under a Subscription and Technology Transfer Agreement in the third quarter of 2019.

General and Administrative Expenses

General and administrative expenses were \$12.5 million for the year ended December 31, 2020 as compared to \$7.0 million for the year ended December 31, 2019. The increase of \$5.5 million in our general and administrative expenses year over year includes:

- \$2.6 million of additional personnel costs primarily driven by an increase in headcount to support overall growth including an increase of \$1.4 million in stock-based compensation expense;
- \$1.9 million of increased insurance costs, primarily as a result of being a public company for a full year; and
- \$1.0 million of additional services, including legal, audit and accounting, public relations, recruiting and other consulting fees and other general and administrative expenses, primarily as a result of being a public company.

Other Income

Interest income has decreased \$1.2 million for the year ended December 31, 2020 as compared to the year ended December 31, 2019 primarily as a result of a significant decrease in interest rates beginning in March 2020.

Liquidity and Capital Resources

Since our inception in April 2017 through December 31, 2020, our operations have been financed by proceeds of \$86.4 million from the sale of convertible notes and our convertible preferred stock and proceeds of \$71.0 million from the sale of common stock in our initial public offering. As of December 31, 2020, we had \$108.7 million in cash, cash equivalents and investments. Cash in excess of immediate requirements is invested in accordance with our investment policy, primarily with a view to liquidity and capital preservation.

We have incurred losses since our inception and, as of December 31, 2020, we had an accumulated deficit of \$66.3 million. Our primary use of cash is to fund operating expenses, which consist primarily of research and development expenditures, and to a lesser extent, general and administrative expenditures. Cash used to fund operating expenses is impacted by the timing of when we pay these expenses, as reflected in the change in our outstanding prepaid expenses and other current assets, accounts payable and accrued expenses.

Any product candidates we may develop may never achieve commercialization and we anticipate that we will continue to incur losses for the foreseeable future. We expect that our research and development expenses, general and administrative expenses, and capital expenditures will continue to increase. As a result, until such time, if ever, as we can generate substantial product revenue, we expect to finance our cash needs through a combination of equity offerings, debt financings or other capital sources, including potentially collaborations, licenses and other similar arrangements. Our primary uses of capital are, and we expect will continue to be, compensation and related expenses, third-party clinical research, manufacturing and development services, costs relating to the build-out of our headquarters, laboratories and manufacturing facility, license payments or milestone obligations that may arise, laboratory and related supplies, clinical costs, manufacturing costs, legal and other regulatory expenses and general overhead costs.

Based upon our current operating plan, we believe that our existing cash, cash equivalents and investments as of December 31, 2020 will enable us to fund our operating expenses and capital expenditure requirements through at least the third quarter of 2022. We have based this estimate on assumptions that may prove to be wrong, and we could utilize our available capital resources sooner than we currently expect. We will continue to require additional financing to advance our current product candidates through clinical development, to develop, acquire or in-license other potential product candidates and to fund operations for the foreseeable future. We will continue to seek funds through equity offerings, debt financings or other capital sources, including potentially collaborations, licenses and other similar arrangements. However, we may be unable to raise additional funds or enter into such other arrangements when needed on favorable terms or at all. If we do raise additional capital through public or private equity offerings, the ownership interest of our existing stockholders will be diluted, and the terms of these securities may include liquidation or other preferences that adversely affect our stockholders' rights. If we raise additional capital through debt financing, we may be subject to covenants limiting or restricting our ability to take specific actions, such as incurring additional debt, making capital expenditures or declaring dividends. Any failure to raise capital as and when needed could have a negative impact on our financial condition and on our ability to pursue our business plans and strategies. If we are unable to raise capital, we will need to delay, reduce or terminate planned activities to reduce costs.

At-The-Market Offering Sales Agreement

On November 10, 2020, we filed a registration statement on Form S-3 (File No. 333-250006) with the SEC, which was declared effective on November 18, 2020 (the Shelf Registration Statement), in relation to the registration of common stock, preferred stock, debt securities, warrants and/or units of any combination thereof for the purposes of selling, from time to time, our common stock, debt securities or other equity securities in one or more offerings. We also simultaneously entered into a Sales Agreement with Cowen and Company, LLC, to provide for the offering, issuance and sale of up to an aggregate amount of \$75.0 million of our common stock from time to time in "at-the-market" offerings under the Shelf Registration Statement and subject to the limitations thereof. No shares have been sold pursuant to the Sales Agreement as of December 31, 2020.

Because of the numerous risks and uncertainties associated with research, development and commercialization of pharmaceutical products, we are unable to estimate the exact amount of our operating capital requirements. Our future funding requirements will depend on many factors, including, but not limited to:

- the scope, progress, results and costs of researching, developing and manufacturing our lead product candidates or any future product candidates, and conducting preclinical studies and clinical trials;
- the timing of, and the costs involved in, obtaining regulatory approvals or clearances for our lead product candidates or any future product candidates;
- the impact of any business interruptions to our operations or to those of our clinical sites, manufacturers, suppliers, or other vendors resulting from the coronavirus disease (COVID-19) outbreak or similar public health crisis;
- the number and characteristics of any additional product candidates we develop or acquire;
- the timing of any cash milestone payments if we successfully achieve certain predetermined milestones;
- the cost of manufacturing our lead product candidate or any future product candidates and any products we successfully commercialize, including costs associated with building-out our manufacturing capabilities;
- our ability to establish and maintain strategic collaborations, licensing or other arrangements and the financial terms of any such agreements that we may enter into;
- the expenses needed to attract and retain skilled personnel;
- the costs associated with being a public company; and
- the timing, receipt and amount of sales of any future approved or cleared products, if any.

Further, our operating plans may change, and we may need additional funds to meet operational needs and capital requirements for clinical trials and other research and development activities. We currently have no credit facility or committed sources of capital. Because of the numerous risks and uncertainties associated with the development and commercialization of our product candidates, we are unable to estimate the amounts of increased capital outlays and operating expenditures associated with our current and anticipated product development programs.

Cash Flows

The following table summarizes our cash flows for the periods indicated:

	Year Ended December 31,	
	2020	2019
	(in thousands)	
Net cash provided by (used in):		
Operating activities	\$ (26,770)	\$ (16,045)
Investing activities	(7,981)	(693)
Financing activities	(24)	119,925
Net (decrease) increase in cash and cash equivalents	<u>\$ (34,775)</u>	<u>\$ 103,187</u>

Operating Activities

During the year ended December 31, 2020, cash used in operating activities of \$26.8 million was attributable to our net loss of \$33.3 million, offset by the net change of \$1.6 million in our net operating assets and liabilities and non-cash charges of \$4.9 million for stock-based compensation charges, amortization of premium on investments and depreciation.

During the year ended December 31, 2019, cash used in operating activities of \$16.0 million was attributable to our net loss of \$16.9 million, increased by the net change of \$1.5 million in our net operating assets and liabilities and offset by non-cash charges of \$2.4 million for stock-based compensation charges and depreciation.

Investing Activities

During the year ended December 31, 2020, cash used in investing activities of \$8.0 million was attributable to \$11.1 million of purchases of investments and \$0.6 million of purchases of property and equipment, partially offset by proceeds of \$3.7 million from maturities of investments.

During the year ended December 31, 2019, we used \$0.7 million of cash and cash equivalents in investing activities consisting of purchases of property and equipment.

Financing Activities

During the year ended December 31, 2020, cash used in financing activities included \$0.2 million in payments for common stock issuance costs from our IPO in October 2019, offset by \$0.2 million in proceeds from stock option exercises and purchases of shares under the employee stock purchase plan.

During the year ended December 31, 2019, cash provided by financing activities of \$119.9 million was attributable to \$48.7 million of net proceeds upon the issuance of Series B convertible preferred stock in January 2019 and \$71.2 million of net proceeds from the issuance of common stock in our initial public offering in October 2019.

Contractual Obligations and Commitments

In February 2019, we entered into an operating lease agreement for office space in Philadelphia, Pennsylvania. The lease term commenced in May 2019 and will expire in July 2022. The initial annual base rent was \$0.3 million, and such amount will increase by 2% annually on each anniversary of the commencement date.

Our commitments include:

- *The License Agreement.* Under the License Agreement, we are required to make milestone payments upon successful completion of certain development, regulatory and sales milestones on a product-by-product and geographical basis. The payment obligations under the License Agreement are contingent upon future events such as our achievement of specified development, regulatory and commercial milestones and we will be required to make development milestone payments and royalty payments in connection with the sale of products developed under the License Agreement. As of December 31, 2020, we are unable to estimate the timing or likelihood of achieving the milestones or making future product sales. We were also obligated to pay \$2.0 million annually for three years beginning August 2018 for funding to the laboratories of Drs. Payne and Milone.

Under the License Agreement, we must use commercially reasonable efforts to develop and commercialize a product in each subfield. During the term of the License Agreement until the first commercial sale of the first product, we are obligated to pay Penn a non-refundable, non-creditable annual license maintenance fee of \$10,000. We are required to pay certain milestone payments upon the achievement of specified clinical and commercial milestones. Milestone payments are reduced by a certain percentage for the second product that achieves a milestone, by an additional percentage for the third product that achieves a milestone, and so on, for each subsequent product that achieves a milestone. In the event that we are able to successfully develop and launch multiple products under the License Agreement, total milestone payments could be approximately \$21.0 million. Penn is also

eligible to receive tiered royalties at percentage rates in the low single-digits, subject to an annual minimum royalty, on annual worldwide net sales of any products that are commercialized by us or our sublicensees that contain or incorporate, or are covered by, the intellectual property licensed by us. To the extent we sublicense our license rights under the License Agreement, Penn would be eligible to receive tiered sublicense income at percentage rates in the mid-single to low double-digits. We have also entered into a subscription and technology transfer agreement with Penn, pursuant to which we owed Penn an upfront subscription fee, which was paid in 2019, and a nominal non-refundable royalty on net sales of products, a portion of which will be credited toward milestone payments and royalties under this License Agreement. Technology transfer activities would be at our cost and subject to agreement as to the technology to be transferred.

- *Master Translational Research Services Agreement with Penn.* Under the Services Agreement, we have contracted for additional research and development services from various laboratories within Penn. The Services Agreement will expire upon completion of the services for which we have engaged Penn under the Services Agreement. In May 2020, the Company amended its Addendum with the Center for Advanced Retinal and Ocular Therapeutics (CAROT) to expand access to vector manufacturing. The Company may incur additional expenses up to \$1.4 million through the remaining term of the CAROT Amended Addendum.
- *Sponsored Research Agreements.* We have two sponsored research agreements, or SRAs, with Penn for the laboratories of our scientific co-founders Drs. Payne and Milone. In May 2020, the Payne SRA was expanded to include CAAR design and optimization efforts in three additional B cell-mediated autoimmune diseases. In August 2020, this agreement was further amended to extend the term of the original research plan. Under the amended agreements, we are committed to funding a defined research plan through February 2023. The total estimated cost of the agreements is \$11.8 million, which satisfies the \$2.0 million annual obligation under the License Agreement. As of December 31, 2020, \$7.1 million of cost has been incurred pursuant to these agreements.
- *Manufacturing agreements.* In January 2021, we entered into a Development and Manufacturing Services Agreement (Wuxi Agreement) with WuXi Advanced Therapies, Inc. (Wuxi) to serve as our cell processing manufacturing partner for the anticipated MuSK-CAART Phase 1 clinical trial. We have the right to terminate the Wuxi Agreement for convenience or other reasons specified in the Wuxi Agreement upon prior written notice. If we terminate the Wuxi Agreement, we will be obligated to pay an early termination fee of \$1.5 million. In February 2021, we entered into a research service agreement with CHOP for vector manufacturing, with a total cost of \$0.7 million, expected to be incurred during 2021.
- *Other Purchase Commitments.* In the normal course of business, we enter into various purchase commitments with third-party contract manufacturers for the manufacture and processing of our product candidates and related raw materials, contracts with contract research organizations for clinical trials and agreements with vendors for other services and products for operating purposes. These agreements generally provide for termination or cancellation other than for costs already incurred.

Off-Balance Sheet Arrangements

During the periods presented, we did not have, nor do we currently have, any off-balance sheet arrangements as defined under SEC rules.

Critical Accounting Policies and Significant Judgments and Estimates

Our management's discussion and analysis of our financial condition and results of operations is based on our financial statements, which have been prepared in accordance with generally accepted accounting principles, or GAAP. The preparation of these financial statements requires us to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the financial statements, as well as the reported expenses incurred during the reporting periods. Our estimates are based on our historical experience and on various other factors that we believe are reasonable under the circumstances, the results of which form the basis for making judgments about the carrying value of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions. We believe that the accounting policies discussed below are critical to understanding our historical and future performance, as these policies relate to the more significant areas involving management's judgments and estimates.

While our significant accounting policies are described in more detail in Note 2 to our financial statements appearing elsewhere in this Annual Report, we believe that the following accounting policies are those most critical to the judgments and estimates used in the preparation of our financial statements.

Research and Development Costs

We estimate costs of research and development activities conducted by service providers, which include activities under the License Agreement, the conduct of sponsored research, preclinical studies and contract manufacturing activities. We record the estimated costs of research and development activities based upon the estimated amount of services provided and include these costs in the accrued and other current liabilities or prepaid expenses on the balance sheets and within research and development expense on the statements of operations.

We estimate these costs based on factors such as estimates of the work completed and budget provided and in accordance with agreements established with our collaboration partners and third-party service providers. We make significant judgments and estimates in determining the accrued liabilities and prepaid expense balances in each reporting period. As actual costs become known, we adjust our accrued liabilities or prepaid expenses. We have not experienced any material differences between accrued costs and actual costs incurred since our inception.

Stock-based Compensation

We measure our stock-based awards granted to employees and non-employees and shares issued under our employee stock purchase plan based on the estimated fair values of the awards on the respective grant dates. We use the Black-Scholes option-pricing model (Black-Scholes) to estimate the fair value of its stock-based awards and shares purchased under the employee stock purchase plan. The Company recognizes compensation expense for time-based awards on a straight-line basis over the requisite service period, which is generally the vesting period of the award. The Company accounts for forfeitures of stock option awards as they occur.

Black-Scholes requires the use of subjective assumptions to determine the fair value of stock-based awards.

These assumptions include:

Fair value of common stock—Prior to our IPO in October 2019, the fair value of our common stock underlying stock-based awards was estimated on each grant date by our board of directors. In order to determine the fair value of our common stock underlying stock-based awards, our board of directors considered, among other things, a valuation of our common stock prepared by an unrelated third-party valuation firm in accordance with the guidance provided by the American Institute of Certified Public Accountants Practice Guide, *Valuation of Privately-Held-Company Equity Securities Issued as Compensation*.

Expected term—The expected term represents the period that stock-based awards are expected to be outstanding. The expected term for option grants is determined using the simplified method, which is the midpoint between the vesting period and the contractual term of the option.

Expected volatility—As a privately held company prior to our IPO in October 2019, we have a limited trading history for our common stock and, as such, the expected volatility is estimated based on the average volatility for comparable publicly traded biotechnology companies over a period equal to the expected term of the stock-based awards. The comparable companies were chosen based on their similar size, stage in the life cycle or area of specialty. We will continue to apply this process until a sufficient amount of historical information regarding the volatility of our own stock price becomes available.

Risk-free interest rate—The risk-free interest rate is based on the U.S. Treasury zero coupon issues in effect at the time of grant for periods corresponding with the expected term of a stock-based award.

Expected dividend—We have never paid dividends on our common stock and have no plans to pay dividends on our common stock. Therefore, we used an expected dividend yield of zero.

We will continue to use judgment in evaluating the assumptions utilized for our stock-based compensation expense calculations on a prospective basis. In addition to the assumptions used in Black-Scholes, the amount of stock-based compensation expense we recognize in our financial statements includes stock option forfeitures as they occur.

Emerging Growth Company Status

We are an emerging growth company, as defined in the JOBS Act. Under the JOBS Act, emerging growth companies can delay adopting new or revised accounting standards issued subsequent to the enactment of the JOBS Act until such time as those standards apply to private companies. Section 107 of the JOBS Act provides that an emerging growth company may take advantage of the extended transition period provided in Section 7(a)(2)(B) of the Securities Act of 1933 for complying with new or revised accounting standards issued subsequent to the enactment of the JOBS Act until such time as those standards apply to private companies. Section 107 of the JOBS Act provides that we can elect to opt out of the extended transition period at any time, which election is irrevocable. We have elected to use this extended transition period for complying with new or revised accounting standards that have different effective dates for public and private companies until the earlier of the date we (i) are no longer an emerging growth company or (ii) affirmatively and irrevocably opt out of the extended transition period provided in the JOBS Act. As a result, our financial statements may not be comparable to companies that comply with new or revised accounting pronouncements as of public company effective dates.

Subject to certain conditions, as an emerging growth company, we may rely on certain other exemptions and reduced reporting requirements, including without limitation (i) providing an auditor's attestation report on our system of internal controls over financial reporting pursuant to Section 404(b) of the Sarbanes-Oxley Act and (ii) complying with any requirement that may be adopted by the Public Company Accounting Oversight Board regarding mandatory audit firm rotation or a supplement to the auditor's report providing additional information about the audit and the consolidated financial statements, known as the auditor discussion and analysis. We will remain an emerging growth company until the earlier of (a) the last day of the fiscal year in which we have total annual gross revenue of \$1.07 billion or more; (b) the last day of the fiscal year following the fifth anniversary of the date of the completion of our initial public offering; (c) the date on which we have issued more than \$1.0 billion in nonconvertible debt during the previous three years; or (d) the date on which we are deemed to be a large accelerated filer under the rules of the SEC.

Recently Issued Accounting Pronouncements Not Yet Adopted

In February 2016, the Financial Accounting Standards Board, or the FASB, issued ASU 2016-02, *Leases* (Topic 842), with guidance regarding the accounting for and disclosure of leases. The update requires lessees to recognize the liabilities related all leases, including operating leases, with a term greater than 12 months on the balance sheet. This update also requires lessees and lessors to disclose key information about their leasing transactions. This guidance was effective for public companies for annual and interim periods beginning after December 15, 2018. For all other entities, including Emerging Growth Companies, this standard is effective for annual reporting periods beginning after December 15, 2020, and interim periods within annual periods beginning after December 15, 2021. Early adoption is permitted. As an Emerging Growth Company, we will adopt Topic 842

for our annual period ending December 31, 2021, and have not yet finalized our assessment of the impact that ASU 2016-02 will have on our financial statements or financial statement disclosures.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk.

We are exposed to market risks in the ordinary course of our business. These risks primarily include interest rate sensitivities. We held cash and cash equivalents and investments of \$108.7 million as of December 31, 2020. We generally hold our cash in interest-bearing money market treasury fund accounts and our investments are investment grade corporate bonds with high credit quality issuers. Our primary exposure to market risk is interest rate sensitivity, which is affected by changes in the general level of U.S. interest rates. Due to the short-term maturities of our cash equivalents and the low risk profile of our investments, an immediate 100 basis point change in interest rates would not have a material effect on the fair market value of our cash equivalents. Declines in interest rates, however, would reduce future investment income.

We do not have any foreign currency or derivative financial instruments. Inflation generally affects us by increasing our cost of labor and program costs. We do not believe that inflation had a material effect on our results of operations during the years ended December 31, 2020 and 2019.

Item 8. Financial Statements and Supplementary Data.

The financial statements required to be filed pursuant to this Item 8 are appended to this Annual Report. An index of those financial statements is found in Item 15.

Item 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure.

There has been no change of accountants nor any disagreements with accountants on any matter of accounting principles or practices of financial disclosure required to be reported under this Item.

Item 9A. Controls and Procedures.**Evaluation of Disclosure Controls and Procedures**

The Company has established disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act) designed to ensure that information required to be disclosed in the reports that the Company files or submits under the Securities Exchange Act of 1934, as amended, or Exchange Act, is recorded, processed, summarized and reported within the time periods specified in the SEC's rules and forms and is accumulated and communicated to management, including the principal executive officer (our Chief Executive Officer) and principal financial officer (our Chief Financial Officer), to allow timely decisions regarding required disclosure. In addition, the design of disclosure controls and procedures must reflect the fact that there are resource constraints and that management is required to apply judgment in evaluating the benefits of possible controls and procedures relative to their costs.

Our management, with the participation of our Chief Executive Officer and Chief Financial Officer, evaluated, as of December 31, 2020, the effectiveness of our disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act). Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving the desired control objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Our disclosure controls and procedures have been designed to provide reasonable assurance of achieving their objectives. Based on that evaluation, our Chief Executive Officer and Chief Financial Officer concluded that our disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act) were effective at the reasonable assurance level as of December 31, 2020.

Management's Annual Report on Internal Control Over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting. Internal control over financial reporting is a process designed to provide reasonable assurance of the reliability of financial reporting and of the preparation of financial statements for external reporting purposes, in accordance with U.S. generally accepted accounting principles.

Internal control over financial reporting includes policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect transactions and disposition of assets; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with U.S. generally accepted accounting principles, and that receipts and expenditures are being made only in accordance with the authorization of its management and directors; and (3) provide reasonable assurance regarding the prevention or timely detection of unauthorized acquisition, use, or disposition of our assets that could have a material effect on its financial statements.

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

Our management has assessed the effectiveness of our internal control over financial reporting as of December 31, 2020. In making this assessment, management used the criteria established by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in Internal Control - Integrated Framework (2013). These criteria are in the areas of control environment, risk assessment, control activities, information and communication, and monitoring. Management's assessment included extensive documentation, evaluating and testing the design and operating effectiveness of its internal controls over financial reporting.

Based on management's processes and assessment, as described above, management has concluded that, as of December 31, 2020, our internal control over financial reporting was effective.

Attestation Report of the Registered Public Accounting Firm

This Annual Report on Form 10-K does not include an attestation report of our registered public accounting firm due to an exemption established by the JOBS Act for "emerging growth companies."

Changes in Internal Control over Financial Reporting

There was no change in our internal control over financial reporting (as defined in Rule 13a-15(f) of the Exchange Act) that occurred during the fiscal quarter ended December 31, 2020 that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting. As a result of the COVID-19 pandemic, since March 2020, most of our employees have been working remotely. We have not identified any material changes in our internal control over financial reporting as a result of these changes to the working environment. We are continually monitoring and assessing the COVID-19 situation to determine any potential impacts on the design and operating effectiveness of our internal controls over financial reporting.

Item 9B. Other Information.

None.

PART III

Item 10. Directors, Executive Officers and Corporate Governance.

Except as set forth below, the information required by this item is incorporated by reference from our definitive Proxy Statement to be filed with the SEC in connection with our 2021 Annual Meeting of Stockholders within 120 days after the end of the fiscal year ended December 31, 2020.

We have adopted a Code of Business Conduct and Ethics that applies to all of our directors, officers and employees, including our principal executive officer and principal financial officer. The Code of Business Conduct and Ethics is posted on our website at <http://investors.cabalettabio.com/corporate-governance/governance-highlights>.

We intend to satisfy the disclosure requirement under Item 5.05 of Form 8-K regarding an amendment to, or waiver from, a provision of this Code of Business Conduct and Ethics by posting such information on our website, at the address and location specified above and , to the extent required by the listing standards of The Nasdaq Global Select Market, by filing a Current Report on Form 8-K with the SEC, disclosing such information.

Item 11. Executive Compensation.

The information required by this Item 11 will be included in our definitive proxy statement to be filed with the SEC with respect to our 2021 Annual Meeting of Stockholders within 120 days after the end of the fiscal year ended December 31, 2020 and is incorporated herein by reference.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters.

The information required by this Item 12 will be included in our definitive proxy statement to be filed with the SEC with respect to our 2021 Annual Meeting of Stockholders within 120 days after the end of the fiscal year ended December 31, 2020 and is incorporated herein by reference.

Item 13. Certain Relationships and Related Transactions, and Director Independence.

The information required by this Item 13 will be included in our definitive proxy statement to be filed with the SEC with respect to our 2021 Annual Meeting of Stockholders within 120 days after the end of the fiscal year ended December 31, 2020 and is incorporated herein by reference.

Item 14. Principal Accounting Fees and Services.

The information required by this Item 14 will be included in our definitive proxy statement to be filed with the SEC with respect to our 2021 Annual Meeting of Stockholders within 120 days after the end of the fiscal year ended December 31, 2020 and is incorporated herein by reference.

PART IV

Item 15. Exhibits, Financial Statement Schedules.

(a) The following documents are filed as part of this Annual Report on Form 10-K:

(1) Financial Statements:

	<u>Page</u>
Report of Independent Registered Public Accounting Firm	F-2
Balance Sheets as of December 31, 2020 and 2019	F-3
Statements of Operations and Comprehensive Loss for the Years Ended December 31, 2020 and 2019	F-4
Statements of Convertible Preferred Stock and Stockholders' (Deficit) Equity for the Years Ended December 31, 2020 and 2019	F-5
Statements of Cash Flows for the Years Ended December 31, 2020 and 2019	F-6
Notes to Financial Statements	F-7

(2) Financial Statement Schedules:

All financial statement schedules have been omitted because they are not applicable, not required or the information required is shown in the financial statements or the notes thereto.

(3) Exhibits. The exhibits required by Item 601 of Regulation S-K and Item 15(b) of this Annual Report on Form 10-K are listed in the Exhibit Index immediately preceding the signature page of this Annual Report on Form 10-K. The exhibits listed in the Exhibit Index are incorporated by reference herein.

Item 16. Form 10-K Summary

None.

INDEX TO FINANCIAL STATEMENTS

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<u>Report of Independent Registered Public Accounting Firm</u>	F-2
<u>Balance Sheets as of December 31, 2020 and 2019</u>	F-3
<u>Statements of Operations and Comprehensive Loss for the Years Ended December 31, 2020 and 2019</u>	F-4
<u>Statements of Convertible Preferred Stock and Stockholders' (Deficit) Equity for the Years Ended December 31, 2020 and 2019</u>	F-5
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Report of Independent Registered Public Accounting Firm

To the Stockholders and the Board of Directors of Cabaletta Bio, Inc.

Opinion on the Financial Statements

We have audited the accompanying balance sheets of Cabaletta Bio, Inc. (the Company) as of December 31, 2020 and 2019, the related statements of operations and comprehensive loss, convertible preferred stock and stockholders' (deficit) equity and cash flows for the years then ended, and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company at December 31, 2020 and 2019, and the results of its operations and its cash flows for the years then ended, in conformity with U.S. generally accepted accounting principles.

Basis for Opinion

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

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

Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ Ernst & Young LLP

We have served as the Company's auditor since 2018
Philadelphia, Pennsylvania
March 16, 2021

CABALETTA BIO, INC.
Balance Sheets
(in thousands, except share and per share amounts)

	December 31,	
	2020	2019
Assets		
Current assets:		
Cash and cash equivalents	\$ 101,429	\$ 136,204
Short-term investments	7,233	—
Prepaid expenses and other current assets	4,873	4,348
Total current assets	113,535	140,552
Property, plant and equipment, net	890	815
Other assets	299	101
Total Assets	\$ 114,724	\$ 141,468
Liabilities and stockholders' equity		
Current liabilities:		
Accounts payable	\$ 1,243	\$ 920
Accrued and other current liabilities	3,937	2,227
Total current liabilities	5,180	3,147
Commitments and contingencies (see Note 7)		
Stockholders' equity:		
Preferred stock, \$0.00001 par value: 10,000,000 shares authorized as of December 31, 2020 and 2019, respectively; no shares issued or outstanding at December 31, 2020 and 2019, respectively		
	—	—
Voting and non-voting common stock, \$0.00001 par value: 150,000,000 (143,590,481 voting and 6,409,519 non-voting) shares authorized as of December 31, 2020 and 2019, respectively; 24,062,775 (19,387,160 voting and 4,675,615 non-voting) shares issued and outstanding as of December 31, 2020 and 24,034,022 (17,624,503 voting and 6,409,519 non-voting) issued and outstanding as of December 31, 2019, respectively		
	—	—
Additional paid-in capital	175,836	171,280
Accumulated other comprehensive income	6	—
Accumulated deficit	(66,298)	(32,959)
Total stockholders' equity	109,544	138,321
Total liabilities and stockholders' equity	\$ 114,724	\$ 141,468

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

CABALETTA BIO, INC.
Statements of Operations and Comprehensive Loss
(in thousands, except share and per share amounts)

	Year Ended December 31,	
	2020	2019
Operating expenses:		
Research and development	\$ 21,376	\$ 11,671
General and administrative	12,457	7,012
Total operating expenses	<u>33,833</u>	<u>18,683</u>
Loss from operations	(33,833)	(18,683)
Other income:		
Interest income	494	1,740
Net loss	(33,339)	(16,943)
Deemed dividend	—	(5,326)
Net loss attributable to common stockholders	<u>\$ (33,339)</u>	<u>\$ (22,269)</u>
Other comprehensive income:		
Net unrealized gain on available-for-sale investments, net of tax	\$ 6	\$ —
Net comprehensive loss	<u>\$ (33,333)</u>	<u>\$ (22,269)</u>
Net loss per voting and non-voting share, basic and diluted	\$ (1.44)	\$ (4.07)

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

CABALETTA BIO, INC.
Statements of Convertible Preferred Stock and Stockholders' (Deficit) Equity
(in thousands, except share and per share amounts)

	Convertible Preferred Stock		Common Stock			Accumulated Other Comprehensive Income	Accumulated Deficit	Total Stockholders' (Deficit) Equity
	Shares	Amount	Shares	Amount	Additional Paid-in Capital			
Balance—December 31, 2018	12,393,047	\$ 43,921	3,848,320	\$ —	\$ 1,762	\$ —	\$ (12,452)	\$ (10,69)
Issuance of convertible preferred stock, net of issuance costs of \$1,293	6,963,788	48,707	—	—	—	—	—	—
Issuance of common stock upon completion of initial public offering, net of issuance costs of \$3,408	—	—	7,275,501	—	71,020	—	—	71,02
Issuance of common stock in conjunction with exercise of stock options	—	—	5,667	—	6	—	—	—
Exchange of convertible preferred stock, including deemed dividend	—	5,326	—	—	(1,762)	—	(3,564)	(5,32
Conversion of convertible preferred stock into common stock on a 1.5 for 1 basis	(19,356,835)	(97,954)	12,904,534	—	97,954	—	—	97,95
Stock-based compensation	—	—	—	—	2,300	—	—	2,30
Net loss	—	—	—	—	—	—	(16,943)	(16,94
Balance—December 31, 2019	—	\$ —	24,034,022	\$ —	\$ 171,280	\$ —	\$ (32,959)	\$ 138,32
Issuance of common stock in connection with exercise of stock options	—	—	25,611	—	139	—	—	13
Issuance of common stock under employee stock purchase plan	—	—	3,142	—	29	—	—	2
Net unrealized gains on available-for-sale securities	—	—	—	—	—	6	—	—
Stock-based compensation	—	—	—	—	4,388	—	—	4,38
Net loss	—	—	—	—	—	—	(33,339)	(33,33
Balance—December 31, 2020	—	\$ —	24,062,775	\$ —	\$ 175,836	\$ 6	\$ (66,298)	\$ 109,54

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

CABALETTA BIO, INC.
Statements of Cash Flows
(in thousands)

	Year Ended December 31,	
	2020	2019
Cash flows from operating activities:		
Net loss	\$ (33,339)	\$ (16,943)
Adjustments to reconcile net loss to net cash used in operating activities:		
Stock-based compensation	4,388	2,300
Amortization of premium on investments	119	—
Depreciation	354	104
Changes in operating assets and liabilities:		
Prepaid expenses and other current assets	(524)	(3,372)
Other assets	(198)	(101)
Accounts payable	555	246
Accrued and other current liabilities	1,875	1,721
Net cash used in operating activities	<u>(26,770)</u>	<u>(16,045)</u>
Cash flows from investing activities:		
Purchases of property and equipment	(635)	(693)
Purchases of investments	(11,097)	—
Proceeds from maturities of investments	3,751	—
Net cash used in investing activities	<u>(7,981)</u>	<u>(693)</u>
Cash flows from financing activities:		
Proceeds from issuance of common stock, net of issuance costs	(192)	71,212
Proceeds from issuance of convertible preferred stock	—	50,000
Issuance costs of convertible preferred stock	—	(1,293)
Proceeds from issuance of common stock in connection with the exercise of stock options	139	6
Proceeds from the issuance of common stock under employee stock purchase plan	29	—
Net cash (used in) provided by financing activities	<u>(24)</u>	<u>119,925</u>
Net (decrease) increase in cash and cash equivalents	(34,775)	103,187
Cash and cash equivalents—beginning of year	136,204	33,017
Cash and cash equivalents—end of year	<u>\$ 101,429</u>	<u>\$ 136,204</u>
Supplemental disclosures of non-cash investing and financing activities:		
Conversion of convertible preferred stock into common stock	\$ —	\$ 97,954
Exchange of convertible preferred stock, including deemed dividend	\$ —	\$ 10,090
Deferred offering costs in accounts payable and accrued and other current liabilities	\$ —	\$ 192
Property and equipment purchases included in accounts payable	\$ 20	\$ 226

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

CABALETTA BIO, INC.

Notes to the Financial Statements
(in thousands, except share and per share amounts)

1. Basis of Presentation

Cabaletta Bio, Inc. (the Company or Cabaletta) was incorporated in April 2017 in the State of Delaware as Tycho Therapeutics, Inc. and, in August 2018, changed its name to Cabaletta Bio, Inc. The Company is headquartered in Philadelphia, Pennsylvania. Cabaletta is a clinical-stage biotechnology company focused on the discovery and development of engineered T cell therapies for B cell-mediated autoimmune diseases.

Principal operations commenced in April 2018, when the Company executed two sponsored research agreements with the Trustees of the University of Pennsylvania (Penn).

On October 16, 2019, the Company effected a 1-for-1.5 reverse split of the Company's issued and outstanding shares of common stock, par value \$0.00001 per share (Common Stock). Upon the effectiveness of the reverse stock split: (i) all shares of outstanding Common Stock were adjusted; (ii) the conversion price of the Series A convertible preferred stock (Series A Preferred), Series A-1 convertible preferred stock (Series A-1 Preferred), Series A-2 convertible preferred stock (Series A-2 Preferred) and Series B convertible preferred stock (Series B Preferred; collectively, the Preferred Shares) was adjusted; (iii) the number of shares of Common Stock for which each outstanding option to purchase Common Stock is exercisable was adjusted; and (iv) the exercise price of each outstanding option to purchase Common Stock was adjusted. All of the outstanding Common Stock share numbers (including shares of Common Stock subject to the Company's options and as converted for the outstanding convertible preferred stock shares), share prices, exercise prices and per share amounts contained in the financial statements have been retroactively adjusted in the financial statements to reflect this reverse stock split for all periods presented. The par value per share and the authorized number of shares of Common Stock and convertible preferred stock were not adjusted as a result of the reverse stock split.

On October 29, 2019, the Company completed its initial public offering (IPO) of 6,800,000 shares of Common Stock at an offering price of \$11.00 per share. The Company received net proceeds of \$66,156 after deducting underwriting discounts, commissions and estimated offering expenses. In connection with the IPO, the Company's outstanding shares of convertible preferred stock were automatically converted into 12,904,534 shares of Common Stock. In November 2019, the underwriters partially exercised their option and purchased an additional 475,501 shares of Common Stock resulting in net proceeds to the Company of \$4,864, after deducting underwriting discounts and commissions.

Risks and Uncertainties

The Company does not expect to generate revenue from sales of engineered T cell therapies for B cell-mediated autoimmune diseases or any other revenue unless and until the Company completes preclinical and clinical development and obtains regulatory approval for one or more product candidates. If the Company seeks to obtain regulatory approval for any of its product candidates, the Company expects to incur significant commercialization expenses.

The Company is subject to risks common to companies in the biotechnology industry including, but not limited to, new technological innovations, protection of proprietary technology, dependence on key personnel, compliance with government regulations and the need to obtain additional financing. As a result, the Company is unable to predict the timing or amount of increased expenses or when or if the Company will be able to achieve or maintain profitability. Further, the Company is currently dependent on University of Pennsylvania (Penn) for much of its preclinical research, clinical research and development activities and initial manufacturing activities (Note 6). Product candidates currently under development will require significant additional research and development efforts, including extensive preclinical and clinical testing and regulatory approval, prior to commercialization. Even if the Company is able to generate revenues from the sale of its product candidates, if approved, it may not become profitable. If the Company fails to become profitable or is unable to sustain profitability on a continuing basis, then it may be unable to continue its operations at planned levels and be forced to reduce its operations.

In December 2019, a novel strain of coronavirus surfaced in Wuhan, China and has since reached multiple other regions and countries. The COVID-19 pandemic is evolving, and to date has led to the implementation of various responses, including government-imposed quarantines, travel restrictions and other public health safety measures, which have delayed the commencement of non-COVID-19-related clinical trials, among other

restrictions. The Company's financial results for the year ended December 31, 2020 were not significantly impacted by COVID-19, however, the Company cannot at this time predict the specific extent, duration, or full impact that the COVID-19 pandemic, including new information that may emerge concerning the severity of COVID-19, the impact of new strains of the virus, the effectiveness and availability of vaccines and the actions to contain COVID-19 or treat its impact will have on its financial condition, operations, and business plans, including its ability to raise additional capital, the timing and enrollment of patients in its ongoing and planned clinical trials, future financings and other expected milestones of its product candidates.

Liquidity

The Company has sustained annual operating losses since inception and expects to continue to generate operating losses for the foreseeable future. The Company's ultimate success depends on the outcome of its research and development activities. The Company had cash and cash equivalents and investments of \$108,662 as of December 31, 2020. Through December 31, 2020, the Company has incurred an accumulated deficit of \$66,298. Management expects to incur additional losses in the future as it continues its research and development and will need to raise additional capital to fully implement its business plan and to fund its operations.

The Company intends to raise such additional capital through a combination of equity offerings, debt financings, government funding arrangements, strategic alliances or other sources. However, if such financing is not available at adequate levels and on a timely basis, or such agreements are not available on favorable terms, or at all, as and when needed, the Company will need to reevaluate its operating plan and may be required to delay or discontinue the development of one or more of its product candidates or operational initiatives. The Company expects that its cash, cash equivalents and investments as of December 31, 2020 will be sufficient to fund its projected operations for at least 12 months from the date the Company's Annual Report on Form 10-K is filed with the Securities and Exchange Commission (SEC).

2. Summary of Significant Accounting Policies

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America (GAAP) requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities as of the date of the financial statements and the reported amounts of expenses during the reporting period. Significant estimates and assumptions made in the accompanying financial statements include but are not limited to the fair value of common stock, stock-based compensation and the valuation allowance on the Company's deferred tax assets. The Company evaluates its estimates and assumptions on an ongoing basis using historical experience and other factors and adjusts those estimates and assumptions when facts and circumstances dictate. Actual results could differ from those estimates.

Off-Balance Sheet Risk and Concentrations of Credit Risk

Financial instruments, which potentially subject the Company to significant concentrations of credit risk, consist primarily of cash and cash equivalents, which are primarily invested in U.S. treasury-based money market funds, and available-for-sale debt securities, which are invested in investment grade corporate bonds with high credit quality issuers. These investments have maturities in 2021. A portion of the Company's cash is maintained at a federally insured financial institution. The deposits held at this institution are in excess of federally insured limits. The Company has not experienced any losses in such accounts and management believes that the Company is not exposed to significant credit risk due to the financial position of the depository institution in which those deposits are held. The cash in this account is swept daily into U.S. treasury-based and U.S. government-based money market funds. The Company has no off-balance sheet risk, such as foreign exchange contracts, option contracts, or other foreign hedging arrangements.

Cash and Cash Equivalents

The Company considers all highly liquid investments purchased with original maturities of three months or less from the purchase date to be cash equivalents. Cash equivalents consist primarily of amounts invested in money market accounts.

Investments

Investments are available-for-sale and carried at estimated fair value. The Company's valuations of available-for-sale debt securities are generally derived from independent pricing services based upon quoted prices in active markets for similar securities, with prices adjusted for yield and number of days to maturity, or based on industry models using data inputs, such as interest rates and prices that can be directly observed or corroborated in active markets. Management determines the appropriate classification of its investments in debt securities at the time of purchase and at the end of each reporting period. Investments with original maturities beyond three months at the date of purchase and which mature at, or less than, twelve months from the balance sheet date are classified as current.

Unrealized gains and losses are excluded from earnings and are reported as a component of comprehensive income. The Company periodically evaluates whether declines in fair values of its available-for-sale securities below their book value are other-than-temporary. This evaluation consists of several qualitative and quantitative factors including the severity and duration of the unrealized loss as well as the Company's ability and intent to hold the available-for-sale security until a forecasted recovery occurs. Additionally, the Company assesses whether it has plans to sell the security or if more likely than not it will be required to sell any available-for-sale securities before recovery of its amortized cost basis. Realized gains and losses and declines in fair value judged to be other-than-temporary, if any, on available-for-sale securities are included in interest and other income, net. The cost of investments sold is based on the specific-identification method. Interest income on investments as well as amortization of discount or premium is included in interest income.

Property, Plant and Equipment

Property, plant and equipment are recorded at cost less accumulated depreciation. Cost includes the acquisition costs and all costs necessary to bring the asset to the location and working condition necessary for its intended use. Depreciation expense is recognized using the straight-line method over the estimated useful life of each asset. Upon retirement or sale, the cost of assets disposed of and the related accumulated depreciation are removed from the accounts and any resulting gain or loss is included in the accompanying statements of operations. Expenditures for normal, recurring or periodic repairs and maintenance related to property and equipment are charged to expense as incurred. The cost for planned major maintenance activities, including the related acquisition or construction of assets, is capitalized if it will result in future economic benefits.

Estimated useful lives for property and equipment are as follows:

Property and equipment	Estimated useful life
Laboratory equipment	Three years
Furniture and fixtures	Three years
Computer equipment	Three years
Leaschold improvements	Lesser of estimated useful life or remaining lease term

Fair Value Measurement

Assets and liabilities recorded at fair value on a recurring basis in the balance sheets are categorized based upon the level of judgment associated with the inputs used to measure their fair values. Fair value is defined as the exchange price that would be received for an asset or an exit price that would be paid to transfer a liability in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants on the measurement date. Valuation techniques used to measure fair value must maximize the use of observable inputs and minimize the use of unobservable inputs. The authoritative guidance on fair value measurements establishes a three-tier fair value hierarchy for disclosure of fair value measurements as follows:

Level 1—Observable inputs such as unadjusted, quoted prices in active markets for identical assets or liabilities at the measurement date.

Level 2—Inputs (other than quoted prices included in Level 1) that are either directly or indirectly observable for the asset or liability. These include quoted prices for similar assets or liabilities in active markets and quoted prices for identical or similar assets or liabilities in markets that are not active.

Level 3—Unobservable inputs that are supported by little or no market activity and that are significant to the fair value of the assets or liabilities.

Research and Development Expenses

Research and development costs include costs incurred for internal and external research and development activities and are expensed as incurred in the accompanying statements of operations. Research and development costs consist of salaries and benefits, including associated stock-based compensation, and laboratory supplies and facility costs, as well as fees paid to entities that conduct certain research and development activities on the Company's behalf.

The Company records accrued liabilities for estimated costs of research and development activities conducted by service providers, which include activities under agreements with Penn (Note 6), the conduct of sponsored research, preclinical studies and contract manufacturing activities. The Company records the estimated costs of research and development activities based upon the estimated amount of services provided and includes these costs in accrued and other current liabilities and prepaid expenses and other current assets in the accompanying balance sheets and within research and development expense in the accompanying statements of operations. Non-refundable advance payments made for goods or services that will be used or rendered for future research and development activities are deferred and capitalized and recognized as expense as the goods are received or the related services are rendered.

The Company accrues for these costs based on factors such as estimates of the work completed and in accordance with agreements established with service providers. The Company makes significant judgments and estimates in determining the accrued liabilities and prepaid expenses in each reporting period. As actual costs become known, the Company adjusts its accrued liabilities and prepaid expenses. The Company has not experienced any material differences between accrued costs and actual costs incurred since its inception.

Stock-based Compensation

The Company measures its stock-based awards granted to employees and non-employees based on the estimated fair values of the awards on the respective grant dates. The Company uses the Black-Scholes option-pricing model (Black-Scholes) to estimate the fair value of its stock-based awards. The Company recognizes compensation expense for time-based awards on a straight-line basis over the requisite service period, which is generally the vesting period of the award. The Company accounts for forfeitures of stock option awards as they occur.

Prior to the Company's IPO, the assumptions used in the Company's Black-Scholes option-pricing model represented management's best estimates and involve a number of variables, uncertainties and assumptions and the application of management's judgment, as they are inherently subjective.

Income Taxes

The Company uses the asset and liability method of accounting for income taxes. Deferred tax assets and liabilities are recognized for the estimated future tax consequences attributable to temporary differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax base. Deferred tax assets and liabilities, which relate primarily to the carrying amount of the Company's property and equipment and its net operating loss carryforwards, are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. Deferred tax expense or benefit is the result of changes in the deferred tax assets and liabilities. Valuation allowances are established when necessary to reduce deferred tax assets where, based upon the available evidence, the Company concludes that it is more-likely-than-not that the deferred tax assets will not be realized. In evaluating its ability to recover deferred tax assets, the Company considers all available positive and negative evidence, including its operating results, ongoing tax planning and forecasts of future taxable income on a jurisdiction-by-jurisdiction basis. Because of the uncertainty of the realization of deferred tax assets, the Company has recorded a full valuation allowance against its deferred tax assets.

Reserves are provided for tax benefits for which realization is uncertain. Such benefits are only recognized when the underlying tax position is considered more-likely-than-not to be sustained on examination by a taxing authority, assuming they possess full knowledge of the position and facts. Interest and penalties related to uncertain tax positions are recognized in the provision of income taxes; however, the Company currently has no interest or penalties related to uncertain income tax benefits.

Net Loss Per Share

The Company calculates basic and diluted net loss per share attributable to common stockholders in conformity with the two-class method required for participating securities. The Company has voting and non-voting common stock. The rights, including the liquidation and dividend rights, of the holders of the voting and non-voting common stock are identical, except with respect to voting. Each share of non-voting common stock may be converted at any time into one share of voting common stock at the option of its holder by providing written notice to the Company, subject to the limitations provided for in the amended and restated certificate of incorporation. The Company also considers its unvested shares of common stock held by the Company's founders and, prior to its conversion to common stock, its convertible preferred stock to be participating securities as, in the event a dividend is paid on common stock, the holders of convertible preferred stock and unvested shares of common stock would be entitled to receive dividends on a basis consistent with the common stockholders.

Basic net loss per share attributable to common stockholders is computed by dividing the net loss attributable to common stockholders by the weighted average number of shares of common stock, which excludes unvested shares of common stock. The undistributed loss for each year is allocated to common stockholders based on the contractual participation rights of the voting and non-voting common stock as if the losses for the year had been distributed. As the liquidation and dividend rights are identical, the undistributed losses are allocated on a proportionate basis. Net loss attributable to common stockholders for the year ended December 31, 2019 is calculated by adjusting the net loss of the Company for the deemed dividend associated with the exchange of Series A-2 Preferred for Series B Preferred. Diluted net loss per share attributable to common stockholders is computed under the if-converted method and assumes that all non-voting common stock has been converted to common stock. Since the Company was in a loss position for all periods presented, the effects of the other potentially dilutive securities are antidilutive.

Segments

Operating segments are defined as components of an entity for which separate financial information is available and that is regularly reviewed by the Chief Operating Decision Maker (CODM) in deciding how to allocate resources to an individual segment and in assessing performance. The Company's CODM is its Chief Executive Officer. The Company has determined it operates in a single operating segment and has one reportable segment.

Related Party Transactions

The Company engaged a firm controlled by a former executive (until February 2019) of the Company for professional services related to accounting, finance and other administrative functions. For the years ended December 31, 2020 and 2019, the costs incurred under this arrangement totaled \$311 and \$601, respectively. These amounts were recorded as general and administrative expense in the accompanying statements of operations. As of December 31, 2020 and 2019, amounts owed under this arrangement totaled \$13 and \$36, respectively, and are included in accounts payable in the accompanying balance sheets.

Emerging Growth Company Status

The Company is an emerging growth company, as defined in the Jumpstart Our Business Startups Act of 2012 (the JOBS Act). Under the JOBS Act, emerging growth companies can delay adopting new or revised accounting standards issued subsequent to the enactment of the JOBS Act, until such time as those standards apply to private companies. The Company has elected to use this extended transition period for complying with new or revised accounting standards that have different effective dates for public and private companies until the earlier of the date that it (i) is no longer an emerging growth company or (ii) affirmatively and irrevocably opts out of the extended transition period provided in the JOBS Act. As a result, these financial statements may not be comparable to companies that comply with the new or revised accounting pronouncements as of public company effective dates.

Recently Issued Accounting Pronouncements Not Yet Adopted

In February 2016, the Financial Accounting Standards Board (FASB) issued ASU 2016-02, *Leases* (Topic 842), with guidance regarding the accounting for and disclosure of leases. The update requires lessees to recognize the liabilities related all leases, including operating leases, with a term greater than 12 months on the balance sheet. This update also requires lessees and lessors to disclose key information about their leasing transactions. This guidance will be effective for public companies for annual and interim periods beginning after December 15, 2018. For all other entities, including Emerging Growth Companies, this standard is effective for annual reporting periods beginning after December 15, 2020, and interim periods within annual periods beginning after December 15, 2021. Early adoption is permitted. As an Emerging Growth Company, the Company expects to adopt Topic 842 for its annual period ending December 31, 2021 and has not yet finalized the assessment of the impact that ASU 2016-02 will have on its financial statements or financial statement disclosures.

3. Fair Value Measurements

As of December 31, 2020 and 2019, the Company's financial instruments included cash and cash equivalents, available-for-sale debt securities, accounts payable and accrued expenses. The carrying amounts for cash and cash equivalents, accounts payable and accrued expenses reported in the Company's financial statements for these instruments approximate their respective fair values because of the short-term nature of these instruments.

The following tables present information about the Company's financial assets measured at fair value on a recurring basis and indicate the level of the fair value hierarchy utilized to determine such fair values:

	December 31, 2020			
	Total	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Financial assets				
Cash and cash equivalents:				
Money market funds	\$ 101,429	\$ 101,429	\$ —	\$ —
Short-term investments:				
Corporate bonds	7,233	—	7,233	—
Total	<u>\$ 108,662</u>	<u>\$ 101,429</u>	<u>\$ 7,233</u>	<u>\$ —</u>

	December 31, 2019			
	Total	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Financial assets				
Cash equivalents:				
Money market funds	\$ 136,204	\$ 136,204	\$ —	\$ —
Total	<u>\$ 136,204</u>	<u>\$ 136,204</u>	<u>\$ —</u>	<u>\$ —</u>

Money market funds are measured at fair value on a recurring basis using quoted prices and are classified as Level 1. Investments are measured at fair value based on inputs other than quoted prices that are derived from observable market data and are classified as Level 2 inputs. There were no transfers of assets between the fair value measurement levels during the years ended December 31, 2020 or 2019.

For debt securities classified as available-for-sale investments, the Company records unrealized gains or losses resulting from changes in fair value between measurement dates as a component of other comprehensive income. The Company did not hold any available-for-sale securities as of December 31, 2019.

	December 31, 2020			
	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Fair value
Financial assets				
Money market funds				
<i>Included in cash and cash equivalents</i>	\$ 101,429	\$ —	\$ —	\$ 101,429
Corporate bonds - due in one year or less				
<i>Included in short-term investments</i>	7,227	6	—	7,233
Total	<u>\$ 108,656</u>	<u>\$ 6</u>	<u>\$ —</u>	<u>\$ 108,662</u>

4. Property, Plant and Equipment

Property plant and equipment consists of the following:

	December 31,	
	2020	2019
Laboratory equipment	\$ 961	\$ 544
Furniture and fixtures	277	277
Leasehold improvements	57	57
Computer equipment	53	41
Total property, plant and equipment	1,348	919
Less: accumulated depreciation	(458)	(104)
Property, plant and equipment, net	\$ 890	\$ 815

Depreciation expense was \$354 and \$104 for the years ended December 31, 2020 and 2019, respectively.

5. Accrued and Other Current Liabilities

Accrued and other current liabilities consist of the following:

	December 31,	
	2020	2019
Research and development services	\$ 1,294	\$ 231
General and administrative services	160	297
Compensation expense	2,445	1,522
Other	38	177
	\$ 3,937	\$ 2,227

6. Collaborations, Licensing Agreements and other Agreements

Amended and Restated License Agreement with the Trustees of the University of Pennsylvania and Children's Hospital of Philadelphia

In August 2018, the Company entered into a license agreement with Penn, as amended and restated in July 2019 to include CHOP as a party, and as amended in May 2020 (the License Agreement) pursuant to which the Company obtained (a) a non-exclusive, non-sublicensable worldwide license to certain of Penn's intellectual property to conduct research, product development, clinical trials, cell manufacturing and other activities, and (b) an exclusive, worldwide, royalty-bearing right and license, with a right to sublicense, on a target-by-target basis, under certain of Penn's intellectual property to make, use, sell, offer for sale, import, and otherwise commercialize products for the treatment of autoimmune and alloimmune diseases.

Unless earlier terminated, the License Agreement expires on the expiration or abandonment or other termination of the last valid claim in Penn's intellectual property licensed by the Company. The Company may terminate the License Agreement at any time for convenience upon 60 days written notice. In the event of an uncured, material breach, Penn may terminate the License Agreement upon 60 days written notice.

Under the terms of the License Agreement, the Company was obligated to pay \$2,000 annually for three years beginning August 2018 for funding to the laboratories of each of Drs. Milone and Payne (see *Sponsored Research Agreements*). During the term of the License Agreement until the first commercial sale of the first product, the Company is obligated to pay Penn a non-refundable, non-creditable annual license maintenance fee of \$10. In May 2020, the Company paid Penn an additional, non-refundable, non-creditable license fee of \$33 under the amended License Agreement.

The Company is required to pay certain milestone payments upon the achievement of specified clinical and commercial milestones. Milestone payments are reduced by a certain percentage for the second product that achieves a milestone, by an additional percentage for the third product that achieves a milestone, and so on, for each subsequent product that achieves a milestone. In the event that the Company is able to successfully develop and launch multiple products under the License Agreement, total milestone payments could be approximately \$21,000. Penn is also eligible to receive tiered royalties at percentage rates in the low single-digits, subject to an annual minimum royalty, on annual worldwide net sales of any products that are commercialized by the Company or its sublicensees that contain or incorporate, or are covered by, the intellectual property licensed by the Company. To the extent the Company sublicenses its license rights under the License Agreement, Penn would be eligible to receive tiered sublicense income at percentage rates in the mid-single to low double-digits. There were no amounts due under the License Agreement as of December 31, 2020.

Sponsored Research Agreements

The Company has sponsored research agreements with two faculty members at Penn, who are also scientific co-founders of the Company and members of the Company's scientific advisory board. In May 2020, one of the agreements was amended to expand the scope of sponsored research. In August 2020, this agreement was further amended to extend the term of the original research plan.

Under the amended agreements, the Company has committed to funding a defined research plan through February 2023. The total estimated cost of \$11,781 under the agreements satisfies the Company's annual obligation under the License Agreement (see *Amended and Restated License Agreement with the Trustees of the University of Pennsylvania* above). As of December 31, 2020, \$7,090 of cost has been incurred pursuant to these agreements. For the years ended December 31, 2020 and 2019, the Company recognized research and development expense of \$2,995 and \$2,137, respectively, related to these agreements in the accompanying statements of operations. As of December 31, 2020 and 2019, \$1,851 and \$1,588 respectively, of advance payments are included in Prepaid expenses and other current assets in the accompanying balance sheets and there was \$217 included in Accrued and other current liabilities in the accompanying balance sheets as of December 31, 2020.

Master Translational Research Services Agreement

In October 2018, the Company entered into a services agreement (the Services Agreement) with Penn for additional research and development services from various laboratories within Penn. The research and development activities are detailed in separately executed Penn organization-specific addenda. In May 2020, the Company amended its Addendum with the Center for Advanced Retinal and Ocular Therapeutics (CAROT) to expand access to vector manufacturing.

Research and development expense related to executed addenda under the master translational research service agreement with Penn recognized in the accompanying statements of operations for the years ended December 31, 2020 and 2019 was \$2,474 and \$2,355, respectively. The Company may incur additional expenses up to \$1,360 through the remaining term of the CAROT Amended Addendum.

Subscription and Technology Transfer Agreement

In July 2019, the Company entered into a subscription and technology transfer agreement pursuant to which the Company owed Penn an upfront subscription fee, which was paid in 2019, and a nominal non-refundable royalty on the net sales of products, a portion of which will be credited toward milestone payments and royalties, respectively, under the Amended License Agreement. Technology transfer activities will be at the Company's cost and subject to agreement as to the technology to be transferred. Under this agreement, the Company recognized \$250 of research and development expense for the year ended December 31, 2019. No expense was recognized under this agreement for the year ended December 31, 2020.

Collaboration and License Agreement

In July 2020, the Company entered into a collaboration and license agreement with Artisan Bio, Inc. (Artisan), wherein the Company and Artisan agreed to collaborate to potentially enhance certain pipeline products of the Company at specific targets using Artisan's gene editing and engineering technology. If the Artisan technology

is applied to any of the Company's products, the Company will be responsible for the development, manufacturing, and commercialization of any such products. Under the terms of the agreement, the Company was required to pay Artisan a nominal upfront fee, as well as costs associated with research and development activities. Artisan is eligible to receive future research, development and regulatory milestones, and is also eligible to receive sales milestones and tiered royalties on net sales of products that incorporate the Artisan technology. The Company can terminate the agreement at will upon advance written notice with payment of a nominal cancellation fee.

7. Commitments and Contingencies

Operating Lease Agreement

In February 2019, the Company entered into an operating lease agreement for new office space in Philadelphia, Pennsylvania. The lease term commenced in May 2019 and will expire in July 2022. The initial annual base rent is \$261, and such amount will increase by 2% annually on each anniversary of the commencement date. The Company records rent expense on a straight-line basis over the lease term. Rent expense related to this lease agreement recognized in the accompanying statement of operations was \$266 and \$178 for the years ended December 31, 2020 and 2019.

As of December 31, 2020, the future minimum payments for operating leases are as follows:

2021	\$	268
2022		158
Thereafter		—
	<u>\$</u>	<u>426</u>

Other Purchase Commitments

In the normal course of business, the Company enters into various purchase commitments with third-party contract manufacturers for the manufacture and processing of its product candidates and related raw materials, contracts with contract research organizations for clinical trials and agreements with vendors for other services and products for operating purposes. These agreements generally provide for termination or cancellation, other than for costs already incurred.

Indemnification

The Company enters into certain types of contracts that contingently requires the Company to indemnify various parties against claims from third parties. These contracts primarily relate to (i) the Company's bylaws, under which the Company must indemnify directors and executive officers, and may indemnify other officers and employees, for liabilities arising out of their relationship, (ii) contracts under which the Company must indemnify directors and certain officers and consultants for liabilities arising out of their relationship, (iii) contracts under which the Company may be required to indemnify partners against certain claims, including claims from third parties asserting, among other things, infringement of their intellectual property rights, and (iv) procurement, consulting, or license agreements under which the Company may be required to indemnify vendors, consultants or licensors for certain claims, including claims that may be brought against them arising from the Company's acts or omissions with respect to the supplied products, technology or services. From time to time, the Company may receive indemnification claims under these contracts in the normal course of business. In addition, under these contracts, the Company may have to modify the accused infringing intellectual property and/or refund amounts received.

In the event that one or more of these matters were to result in a claim against the Company, an adverse outcome, including a judgment or settlement, may cause a material adverse effect on the Company's future business, operating results or financial condition. It is not possible to determine the maximum potential amount under these contracts due to the limited history of prior indemnification claims and the unique facts and circumstances involved in each particular agreement.

8. Convertible Preferred Stock

Preferred Stock

Preferred Stock

The Company has 10,000,000 shares of authorized preferred stock as of December 31, 2020, none of which is issued or outstanding. The preferred stock is not redeemable and does not have a stated voting, dividend or liquidation preference.

Convertible Preferred Stock

The Company has issued Series A Preferred, Series A-1 Preferred, Series A-2 Preferred, and Series B Preferred of Convertible Preferred Stock. The Company classified Convertible Preferred Stock outside of stockholders' equity (deficit) because the shares contained deemed liquidation rights that were a contingent redemption feature not solely within the control of the Company.

	Series A Preferred		Series A-1 Preferred		Series A-2 Preferred		Series B Preferred		Total Convertible Preferred Stock	
	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount	Shares	Amount
Balance—December 31, 2018	3,146,551	12,575	7,372,719	24,994	1,873,777	6,352	—	—	12,393,047	43,921
Issuance	—	—	—	—	—	—	6,963,788	50,000	6,963,788	50,000
Exchange, including deemed dividend	—	—	—	—	(1,405,332)	(4,764)	1,405,332	10,090	—	5,326
Issuance costs	—	—	—	—	—	—	—	(1,293)	—	(1,293)
Conversion to common stock	(3,146,551)	(12,575)	(7,372,719)	(24,994)	(468,445)	(1,588)	(8,369,120)	(58,797)	(19,356,835)	(97,954)
Balance—December 31, 2019	—	\$ —	—	\$ —	—	\$ —	—	\$ —	—	\$ —

In January 2019, the Company's certificate of incorporation was amended to increase the authorized shares of Convertible Preferred Stock to 20,762,168 shares, and the Company issued 6,963,788 shares of Series B Preferred, resulting in gross proceeds of \$50,000. In connection, the Company issued a further 1,405,332 shares of Series B Preferred in exchange for 1,405,332 shares of Series A-2 Preferred. The Company determined the terms of the Series B Preferred to be materially, qualitatively different than the terms of the Series A-2 Preferred and, as such, applied extinguishment accounting with respect to the Series A-2 Preferred received in the exchange resulting in removal of the carrying amount of the Series A-2 Preferred received (\$4,764), the addition of the Series B Preferred issued at fair value determined with reference to the contemporaneous issuance of Series B Preferred (\$10,090) and the difference (\$5,326) determined to be a deemed dividend recorded to additional paid-in capital (to the extent of paid-in capital) and accumulated deficit within stockholders' deficit on the balance sheet.

The shares of Convertible Preferred Stock had various rights, including voting and dividend rights, preferences and privileges, including optional and mandatory conversion rights.

In October 2019, the Convertible Preferred Stock was converted into 12,904,534 shares of Common Stock. Certain holders of the Company's Convertible Preferred Stock elected to have such shares convert into 6,409,519 shares of non-voting Common Stock following the closing of the Company's IPO. The non-voting shares of Common Stock have the same rights and preferences as the Common Stock but are non-voting. No Convertible Preferred Stock was outstanding as of December 31, 2020 or 2019.

9. Common Stock

Common Stock

Pursuant to the Company's Third Amended and Restated Certificate of Incorporation filed in October 2019, the Company is authorized to issue 143,590,481 shares of voting common stock and 6,409,519 shares of non-voting common stock. Holders of voting common stock shall have the exclusive right to vote for the election of directors of the Company and on all other matters requiring stockholder action. Each share of the Company's non-voting common stock may be converted at any time into one share of common stock at the option of its holder by providing written notice to the Company, subject to the limitations provided for in the amended and restated certificate of incorporation. In August 2020, 1,733,904 shares of non-voting common stock were converted to voting common stock.

At-The-Market Offering Sales Agreement

On November 10, 2020, the Company filed a Shelf Registration Statement in relation to the registration of common stock, preferred stock, debt securities, warrants and/or units of any combination thereof for the purposes of selling, from time to time, the Company's common stock, debt securities or other equity securities in one or more offerings. The Company also simultaneously entered into a Sales Agreement with Cowen and Company, LLC, to provide for the offering, issuance and sale of up to an aggregate amount of \$75.0 million of the Company's common stock from time to time in "at-the-market" offerings under the Shelf Registration Statement and subject to the limitations thereof. No shares have been sold under the Sales Agreement as of December 31, 2020.

Share-based Payment Awards

In May 2018, several of the Company's founders agreed to modify their shares of common stock outstanding to include vesting provisions that require continued service to the Company in order to vest in those shares. As such, the 2,904,000 modified shares of common stock became compensatory upon such modification. The fair value of the awards on the modification date was determined to be \$0.74 per share of common stock, based on the issuance of convertible notes in May 2018, considering the maximum conversion price and the seniority of the notes. The total compensation cost resulting from the modification was \$2,126. The total compensation cost is being recognized over the three-year vesting term attendant to the founders' common shares.

During the year ended December 31, 2020, the Company recognized \$495 and \$177 of this amount in research and development expense and general and administrative expense, respectively. During the year ended December 31, 2019, the Company recognized \$529 and \$177 of this amount in research and development expense and general and administrative expense, respectively.

2018 Stock Option and Grant Plan

In September 2018, the Company adopted the 2018 stock option and grant plan (the 2018 Plan), which provided for the Company to sell or issue common stock, or other stock-based awards, to employees, members of the board of directors and consultants of the Company. The Company generally granted stock-based awards with service conditions only (service-based awards), although there was one grant with performance conditions. As of December 31, 2020, there are no unvested options with performance conditions. Stock options granted under the 2018 Plan generally vest over three to four years. There were 1,959,411 options granted under the 2018 Plan prior to the Company's IPO in October 2019. No further grants may be made under the 2018 Plan subsequent to the IPO.

2019 Stock Option and Incentive Plan

The 2019 Stock Option and Incentive Plan (2019 Plan) was approved by the Company's board of directors on October 14, 2019, and became effective on October 23, 2019. The 2019 Plan provides for the grant of incentive stock options, nonqualified stock options, stock appreciation rights, restricted stock units, restricted stock awards, unrestricted stock awards, cash-based awards and dividend equivalent rights to the Company's officers, employees, directors and consultants. The number of shares initially reserved for issuance under the 2019 Plan was 2,342,288, which will be increased each January 1 thereafter by 4% of the number of shares of the Company's common stock outstanding on the immediately preceding December 31 or such lesser number of shares determined by the Company's board of directors or compensation committee of the board of directors. On January 1, 2021, the total number of shares under the 2019 Plan was increased by 962,511 shares. As of December 31, 2020, there were 2,314,303 shares remaining available for issuance.

A summary of the stock option activity is presented below:

	Number of Shares	Weighted Average Exercise Price	Weighted Average Remaining Contractual Term (years)	Aggregate Intrinsic Value
Outstanding as of January 1, 2019	971,353	\$ 1.01	9.8	\$ 4,051
Granted	1,340,839	7.97		
Exercised	(5,667)	1.01		
Cancelled	(176,893)	4.22		
Outstanding as of December 31, 2019	2,129,632	5.12	9.2	\$ 18,844
Granted	813,172	13.03		
Exercised	(25,611)	5.44		183
Forfeited	(16,714)	6.30		
Outstanding as of December 31, 2020	2,900,479	\$ 7.33	8.5	\$ 16,303
Options Exercisable at December 31, 2020	1,068,675	\$ 4.04	8.1	\$ 9,059

The aggregate intrinsic value of options granted is calculated as the difference between the exercise price of the options and the estimated fair value of the Company's common stock. The weighted average grant-date fair value of stock options granted during the year ended December 31, 2020 and 2019 was \$8.31 and \$5.24, respectively.

The fair value of each award is estimated using Black-Scholes based on the following assumptions:

	For the Year Ended December 31,	
	2020	2019
Risk-free interest rate	0.28%—1.48%	1.39%—2.59%
Expected term	5.7—6.1 years	0.3—6.1 years
Expected volatility	70%—79%	70%—76%
Expected dividend yield	0%	0%

Black-Scholes requires the use of subjective assumptions which determine the fair value of stock-based awards. These assumptions include:

Fair value of common stock—Prior to the Company's IPO in October 2019, the fair value of the Company's common stock underlying stock-based awards was estimated on each grant date by the Company's board of directors. In order to determine the fair value of the Company's common stock underlying stock-based awards, the Company's board of directors considered, among other things, a valuation of the Company's common stock prepared by an unrelated third-party valuation firm in accordance with the guidance provided by the American Institute of Certified Public Accountants Practice Guide, *Valuation of Privately-Held-Company Equity Securities Issued as Compensation*.

Expected term—The expected term represents the period that stock-based awards are expected to be outstanding. The expected term for option grants is determined using the simplified method, which is the midpoint between the vesting period and the contractual term of the option.

Expected volatility—As a privately held company prior to the Company's IPO in October 2019, the Company has limited trading history for its common stock and, as such, the expected volatility is estimated based on the average volatility for comparable publicly traded biotechnology companies over a period equal to the expected term of the stock-based awards. The comparable companies were chosen based on their similar size, stage in the life cycle or area of specialty. The Company will continue to apply this process until a sufficient amount of historical information regarding the volatility of its own stock price becomes available.

Risk-free interest rate—The risk-free interest rate is based on the U.S. Treasury zero coupon issues in effect at the time of grant for periods corresponding with the expected term of a stock-based award.

Expected dividend—The Company has never paid dividends on its common stock and has no plans to pay dividends on its common stock. Therefore, the Company used an expected dividend yield of zero.

Stock-based Compensation

The Company has recorded stock-based compensation in the accompanying statements of operations as follows:

	For the Year Ended December 31,	
	2020	2019
Research and development	\$ 1,989	\$ 1,304
General and administrative	2,399	996
Total	\$ 4,388	\$ 2,300

As of December 31, 2020, there was \$9,809 of unrecognized compensation cost related to unvested option awards, which is expected to be recognized over a weighted-average period of 2.8 years. As of December 31, 2020, there was \$239 of unrecognized compensation cost related to unvested founder stock awards, which is expected to be recognized over a weighted-average period of 0.3 years.

2019 Employee Stock Purchase Plan

The 2019 Employee Stock Purchase Plan (2019 ESPP) was approved by the Company's board of directors on October 14, 2019, and became effective on October 23, 2019. A total of 234,229 shares of common stock were initially reserved for issuance under the 2019 ESPP, and will be increased each January 1 thereafter through January 1, 2029 by the least of (i) 234,229 shares of common stock, (ii) 1% of the number of shares of the Company's common stock outstanding on the immediately preceding December 31 or (iii) such lesser number of shares determined by the 2019 ESPP's administrator. On January 1, 2021, the total number of shares under the 2019 ESPP was increased by 234,229 shares.

Employee contributions are made through payroll deductions of up to 15% of eligible compensation over the offering period. A participant may not accrue rights to purchase more than \$25 worth of the Company's common stock for each calendar year in which such right is outstanding. At the end of each offering period, shares of the Company's common stock may be purchased at 85% of the lesser of the Company's common stock on (i) the first trading day of the relevant offering period and (ii) the last trading day of the relevant offering period. The first offering period commenced on July 1, 2020 and ended on November 30, 2020. Thereafter, offerings will be six months in duration and will commence on each December 1 and June 1. The Company recognized stock-based compensation expense of \$18 during the year ended December 31, 2020 related to the 2019 ESPP.

10. Income Taxes

The reconciliation of federal statutory income tax rate to the Company's effective income tax rate is as follows:

	For the Year Ended December 31,	
	2020	2019
Expected income tax benefit at the federal statutory rate	21.0 %	21.0 %
State and local taxes, net of federal benefit	12.5	13.1
Research and development credit, net	2.6	2.3
Non-deductible items and other	(0.8)	(3.3)
Change in valuation allowance	(35.3)	(33.1)
Total	0.0 %	0.0 %

Deferred income taxes reflect the net effects of temporary differences between the carrying amounts of assets and liabilities for financial reporting purposes and the amounts used for income tax purposes. The principal components of the Company's deferred tax assets consisted of the following:

	December 31,	
	2020	2019
Deferred tax assets:		
Federal, state and local net operating loss carryforwards	\$ 15,241	\$ 5,688
License fee deductions	340	362
Research and development tax credits	1,317	452
Stock-based compensation deductions	1,243	264
Accrued expenses	837	457
Gross deferred tax assets	18,978	7,223
Less: valuation allowance	(18,978)	(7,223)
Total deferred tax assets	—	—
Deferred tax liabilities:	—	—
	\$ —	\$ —
Net deferred tax assets	\$ —	\$ —

The Company increased its valuation allowance by \$11,755 for the year ended December 31, 2020 in order to maintain a full valuation allowance against its deferred tax assets. Based on the Company's history of losses, the Company recorded a full valuation allowance against its deferred tax assets as of December 31, 2020. The Company intends to maintain a valuation allowance until sufficient positive evidence exists to support a reversal of the allowance.

As of December 31, 2020, the Company had federal, state and local net operating loss carryforwards of \$45,550, \$47,735 and \$38,645, respectively; \$45,301 of the federal amounts do not expire, and the remaining \$249 expire in 2037. The state net operating losses begin to expire in 2037. The local net operating losses begin to expire in 2039. As of December 31, 2020, the Company had federal research and development tax credit carryforwards of \$1,317, which begin to expire in 2038. Under the provisions of Sections 382 and 383 of the Internal Revenue Code of 1986, as amended (the IRC), these net operating losses, credit carryforwards and other tax attributes may be subject to limitation based on previous significant changes in ownership and upon future significant changes in ownership of the Company, as defined by the IRC.

The Company files income tax returns in the U.S. federal jurisdiction as well as in Pennsylvania and Philadelphia. The tax years 2019, 2018 and 2017 remain open to examination by the jurisdictions where the Company is subject to tax.

The Company evaluates tax positions for recognition using a more-likely-than-not recognition threshold, and those tax positions eligible for recognition are measured as the largest amount of tax benefit that is greater than 50% likely of being realized upon the effective settlement with a taxing authority that has full knowledge of all relevant information. As of December 31, 2020, the Company had no unrecognized income tax benefits that would affect the Company's effective tax rate if recognized.

11. Net Loss Per Share

The Company calculates basic and diluted net loss per share attributable to common stockholders in conformity with the two-class method required for participating securities. For the years ended December 31, 2020 and 2019, the Company had voting and non-voting common stock outstanding. Since the rights of the voting and non-voting common stock are identical, except with respect to voting, the undistributed losses of the Company have been allocated on a proportionate basis to the two classes. Diluted net loss per share is calculated using the if-converted method, which assumes conversion of all non-voting common stock to voting common stock.

	Year ended December 31, 2020	
	Voting common stock	Non-voting common stock
Basic net loss per share:		
Numerator		
Allocation of undistributed losses attributable to common stockholders	\$ (25,090)	\$ (8,249)
Denominator		
Weighted average number of shares used in basic per share computation	17,417,900	5,727,327
Net loss per share, basic	<u>\$ (1.44)</u>	<u>\$ (1.44)</u>
Diluted net loss per share:		
Numerator		
Allocation of undistributed losses for basic computation	\$ (25,090)	\$ (8,249)
Reallocation of undistributed losses as a result of conversion of non-voting to voting common shares	(8,249)	—
Allocation of undistributed losses	<u>\$ (33,339)</u>	<u>\$ (8,249)</u>
Denominator		
Weighted average number of shares used in basic per share computation	17,417,900	5,727,327
Add: Conversion of non-voting to voting common shares outstanding	5,727,327	—
Weighted average number of shares used in diluted per share computation	<u>23,145,227</u>	<u>5,727,327</u>
Net loss per share, diluted	<u>\$ (1.44)</u>	<u>\$ (1.44)</u>

	Year ended December 31, 2019	
	Voting common stock	Non-voting common stock
Basic net loss per share:		
Numerator		
Allocation of undistributed losses attributable to common stockholders	\$ (17,693)	\$ (4,576)
Denominator		
Weighted average number of shares used in basic per share computation	4,345,530	1,123,861
Net loss per share, basic	<u>\$ (4.07)</u>	<u>\$ (4.07)</u>
Diluted net loss per share:		
Numerator		
Allocation of undistributed losses for basic computation	\$ (17,693)	\$ (4,576)
Reallocation of undistributed losses as a result of conversion of non-voting to voting common shares	(4,576)	—
Allocation of undistributed losses	<u>\$ (22,269)</u>	<u>\$ (4,576)</u>
Denominator		
Weighted average number of shares used in basic per share computation	4,345,530	1,123,861
Add: Conversion of non-voting to voting common shares outstanding	1,123,861	—
Weighted average number of shares used in diluted per share computation	<u>5,469,391</u>	<u>1,123,861</u>
Net loss per share, diluted	<u>\$ (4.07)</u>	<u>\$ (4.07)</u>

The following outstanding potentially dilutive shares have been excluded from the calculation of diluted net loss per share, as their effect is anti-dilutive:

	For the Year Ended December 31,	
	2020	2019
Stock options to purchase common stock	2,900,479	2,129,632
Non-vested founder stock	465,801	1,388,977
Total	<u>3,366,280</u>	<u>3,518,609</u>

12. 401(k) Savings Plan

The Company maintains a defined-contribution savings plan under Section 401(k) of the IRC, or the 401(k) Plan. The 401(k) Plan covers all employees who meet defined minimum age and service requirements and allows participants to defer a portion of their annual compensation on a pretax basis. In 2019, the Company made a safe harbor nonelective contribution of 3% of eligible compensation on behalf of all employees. Effective January 1, 2020, the Plan provided for matching contributions on a portion of participant contributions pursuant to the 401(k) Savings Plan's matching formula, up to 4% of eligible compensation. All matching contributions and participant contributions vest immediately. Contributions totaled \$203 and \$74 for the years ended December 31, 2020 and 2019, respectively, and have been recorded in the statements of operations.

13. Subsequent Events

In January 2021, the Company entered into a Development and Manufacturing Services Agreement (Wuxi Agreement) with WuXi Advanced Therapies (Wuxi) to serve as the Company's cell processing manufacturing partner for the anticipated MuSK-CAART Phase 1 clinical trial. The Company has the right to terminate the Wuxi Agreement for convenience or other reasons specified in the Wuxi Agreement upon prior written notice. If the Company terminates the Wuxi Agreement, it will be obligated to pay an early termination fee of \$1,500.

In February 2021, the Company entered into a research service agreement with CHOP for vector manufacturing, with a total cost of \$670, expected to be incurred during 2021.

EXHIBIT INDEX

Exhibit Number	Description
3.1	<u>Third Amended and Restated Certificate of Incorporation of the Registrant, as currently in effect (incorporated by reference to Exhibit 3.1 of the Registrant's Current Report on Form 8-K (File No. 001-39103) filed on October 30, 2019)</u>
3.2	<u>Amended and Restated Bylaws of the Registrant, as currently in effect (incorporated by reference to Exhibit 3.2 of the Registrant's Current Report on Form 8-K (File No. 001-39103) filed on October 30, 2019)</u>
4.1	<u>Specimen Common Stock Certificate (incorporated by reference to Exhibit 4.1 of the Registrant's Registration Statement on Form S-1 (File No. 333-234017) filed on October 16, 2019)</u>
4.2	<u>Amended and Restated Investors' Rights Agreement among the Registrant and certain of its stockholders, dated January 2, 2019 (incorporated by reference to Exhibit 4.2 of the Registrant's Registration Statement on Form S-1 (File No. 333-234017) filed on September 30, 2019)</u>
4.3	<u>Description of Securities (incorporated by reference to Exhibit 4.3 of the Registrant's Annual Report on Form 10-K (File No. 001-39103) filed on March 30, 2020)</u>
10.1#	<u>2018 Stock Option and Grant Plan, as amended, and form of award agreements thereunder (incorporated by reference to Exhibit 10.1 of the Registrant's Registration Statement on Form S-1 (File No. 333-234017) filed on September 30, 2019)</u>
10.2#	<u>2019 Stock Option and Incentive Plan, and form of award agreements thereunder (incorporated by reference to Exhibit 10.2 of the Registrant's Registration Statement on Form S-1/A (File No. 333-234017) filed on October 16, 2019)</u>
10.3#	<u>2019 Employee Stock Purchase Plan (incorporated by reference to Exhibit 10.3 of the Registrant's Registration Statement on Form S-1/A (File No. 333-234017) filed on October 16, 2019)</u>
10.4#	<u>Senior Executive Cash Incentive Bonus Plan (incorporated by reference to Exhibit 10.4 of the Registrant's Quarterly Report on Form 10-Q filed on December 5, 2019)</u>
10.5#	<u>Form of Indemnification Agreement between the Registrant and each of its directors (incorporated by reference to Exhibit 10.5 of the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019)</u>
10.6#	<u>Form of Indemnification Agreement between the Registrant and each of its executive officers (incorporated by reference to Exhibit 10.4 of the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019)</u>
10.7+	<u>Amended and Restated License Agreement, dated as of July 23, 2019, among the Registrant, the Trustees of the University of Pennsylvania and the Children's Hospital of Philadelphia (incorporated by reference to Exhibit 10.6 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019)</u>
10.8+	<u>Sponsored Research Agreement, dated as of April 23, 2018, between the Registrant and the Trustees of the University of Pennsylvania (incorporated by reference to Exhibit 10.7 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019)</u>
10.9+	<u>Sponsored Research Agreement, dated as of April 23, 2018, between the Registrant and the Trustees of the University of Pennsylvania (incorporated by reference to Exhibit 10.8 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019)</u>

- 10.10+ [Master Translational Research Services Agreement, dated as of October 2018, between the Registrant and the Trustees of the University of Pennsylvania \(incorporated by reference to Exhibit 10.9 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.11+ [CAROT Master Services Addendum to Master Translational Research Services Agreement, dated as of February 4, 2019, between the Registrant and the Trustees of the University of Pennsylvania \(incorporated by reference to Exhibit 10.10 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.12+ [CVPE Master Services Addendum to Master Translational Research Services Agreement, dated as of October 22, 2018, between the Registrant and the Trustees of the University of Pennsylvania \(incorporated by reference to Exhibit 10.11 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.13+ [Research Agreement A19-3095, dated as of October 31, 2018, between the Registrant and The Regents of the University of California \(incorporated by reference to Exhibit 10.12 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.14 [Lease, dated as of February 11, 2019, between the Registrant and Brandywine Cira, L.P. \(incorporated by reference to Exhibit 10.13 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.15# [Employment Agreement between the Registrant and Steven Nichtberger \(incorporated by reference to Exhibit 10.16 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.16# [Employment Agreement between the Registrant and Anup Marda \(incorporated by reference to Exhibit 10.17 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.17# [Employment Agreement between the Registrant and Gwendolyn Binder \(incorporated by reference to Exhibit 10.18 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.18# [Employment Agreement between the Registrant and David Chang \(incorporated by reference to Exhibit 10.19 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.19# [Employment Agreement between the Registrant and Brian Stalter \(incorporated by reference to Exhibit 10.20 to the Registrant's Registration Statement on Form S-1, filed with the SEC on September 30, 2019\)](#)
- 10.20# [Non-Employee Director Compensation Policy \(incorporated by reference to Exhibit 10.1 to the Registrant's Annual Report on Form 10-K \(File No. 001-39103\) filed on March 30, 2020\)](#)
- 10.21+ [Amendment No. 1, dated May 27, 2020, to the Sponsored Research Agreement, dated April 23, 2018, between the Registrant and the Trustees of the University of Pennsylvania \(incorporated by reference to Exhibit 10.1 to the Registrant's Current Report on Form 8-K \(File No. 001-39103\) filed on May 28, 2020\)](#)
- 10.22+ [First Amendment, dated May 27, 2020, to the Amended and Restated License Agreement, dated July 23, 2019, among the Registrant, the Trustees of the University of Pennsylvania and the Children's Hospital of Philadelphia \(incorporated by reference to Exhibit 10.2 to the Registrant's Current Report on Form 8-K \(File No. 001-39103\) filed on May 28, 2020\)](#)

10.23+	Amendment to CAROT Master Services Addendum to Master Translational Research Services Agreement, dated as of May 18, 2020 between the Registrant and the Trustees of the University of Pennsylvania (incorporated by reference to Exhibit 10.1 to the Registrant's Quarterly Report on Form 10-Q (File No. 001-39103) filed on August 6, 2020)
10.24+	Amendment No. 2, dated August 17, 2020, to the Sponsored Research Agreement, dated April 23, 2018, as amended by Amendment No. 1 dated May 27, 2020, between the Registrant and the Trustees of the University of Pennsylvania (incorporated by reference to Exhibit 10.1 to the Registrant's Quarterly Report on Form 10-Q (File No. 001-39103) filed on November 10, 2020)
21.1*	List of Subsidiaries of the Registrant
23.1*	Consent of Ernst & Young, independent registered public accounting firm
31.1*	Certification of Principal Executive Officer Pursuant to Rules 13a-14(a) and 15d-14(a) under the Securities Exchange Act of 1934, as amended
31.2*	Certification of Principal Financial Officer Pursuant to Rules 13a-14(a) and 15d-14(a) under the Securities Exchange Act of 1934, as amended
32.1**	Certification of Principal Executive Officer Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to 18 U.S.C. Section 1350, as adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
32.2**	Certification of Principal Financial Officer Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to 18 U.S.C. Section 1350, as adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
101.INS	XBRL Instance Document
101.SCH	XBRL Taxonomy Extension Schema Document
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document
101.LAB	XBRL Taxonomy Extension Label Linkbase Document
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document

Management Contract or compensatory plan or arrangement.

+ Confidential treatment has been granted by the Securities and Exchange Commission as to certain portions.

* Filed herewith.

** The certifications furnished in Exhibit 32.1 and 32.2 hereto are deemed to accompany this Annual Report on Form 10-K and will not be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934, as amended. Such certifications will not be deemed to be incorporated by reference into any filings under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended, except to the extent that the Registrant specifically incorporates it by reference.

List of Subsidiaries

None.

Consent of Independent Registered Public Accounting Firm

We consent to the incorporation by reference in the following Registration Statements:

- (1) Registration Statement (Form S-8 No. 333-234367) pertaining to the Cabaletta Bio, Inc. 2018 Stock Option and Incentive Plan, the Cabaletta Bio, Inc. 2019 Stock Option and Incentive Plan, and the Cabaletta Bio, Inc. 2019 Employee Stock Purchase Plan,
- (2) Registration Statement (Form S-8 No. 333-237484) pertaining to the Cabaletta Bio, Inc. 2019 Stock Option and Incentive Plan and the Cabaletta Bio, Inc. 2019 Employee Stock Purchase Plan, and
- (3) Registration Statement (Form S-3 No. 333-250006) of Cabaletta Bio, Inc.

of our report dated March 16, 2021, with respect to the financial statements of Cabaletta Bio, Inc. included in this Annual Report (Form 10-K) for the year ended December 31, 2020.

/s/ Ernst & Young LLP

Philadelphia, Pennsylvania

March 16, 2021

**CERTIFICATION PURSUANT TO
RULES 13a-14(a) AND 15d-14(a) UNDER THE SECURITIES EXCHANGE ACT OF 1934,
AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Steven Nichtberger, certify that:

1. I have reviewed this Annual Report on Form 10-K for the year ended December 31, 2020 of Cabaletta Bio, Inc. (the “registrant”);
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:
 - (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
 - (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - (c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - (d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 16, 2021

By: _____
/s/ Steven Nichtberger
Steven Nichtberger
Chief Executive Officer and President
(Principal Executive Officer)

**CERTIFICATION PURSUANT TO
RULES 13a-14(a) AND 15d-14(a) UNDER THE SECURITIES EXCHANGE ACT OF 1934,
AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Anup Marda, certify that:

1. I have reviewed this Annual Report on Form 10-K for the year ended December 31, 2020 of Cabaletta Bio, Inc. (the "registrant");
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:
 - (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
 - (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - (c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - (d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 16, 2021

By: _____
/s/ Anup Marda
Anup Marda
Chief Financial Officer
(Principal Financial and Accounting Officer)

**CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002**

In connection with the Annual Report of Cabaletta Bio, Inc. (the "Company") on Form 10-K for the fiscal year ended December 31, 2020 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I certify, pursuant to 18 U.S.C. § 1350, as adopted pursuant to § 906 of the Sarbanes-Oxley Act of 2002, that:

- (1) The Report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934; and
- (2) The information contained in the Report fairly presents, in all material respects, the financial condition and result of operations of the Company.

Date: March 16, 2021

By: _____
/s/ Steven Nichtberger
Steven Nichtberger
Chief Executive Officer
(Principal Executive Officer)

