
**UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, DC 20549**

FORM 10-Q

(Mark One)

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

For the quarterly period ended September 30, 2018
OR

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

For the transition period from _____ to _____
Commission File Number: 001-38550

Translate Bio, Inc.

(Exact Name of Registrant as Specified in its Charter)

Delaware
(State or other jurisdiction of
incorporation or organization)

61-1807780
(I.R.S. Employer
Identification No.)

29 Hartwell Avenue
Lexington, Massachusetts
(Address of principal executive offices)

02421
(Zip Code)

Registrant's telephone number, including area code: (617) 945-7361

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, 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 whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes No

As of October 31, 2018, the registrant had 45,142,090 shares of common stock, \$0.001 par value per share, outstanding.

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PART I—FINANCIAL INFORMATION

Item 1. Financial Statements.

TRANSLATE BIO, INC.
CONDENSED CONSOLIDATED BALANCE SHEETS (UNAUDITED)
(In thousands, except share and per share amounts)

	September 30, 2018	December 31, 2017
Assets		
Current assets:		
Cash and cash equivalents	\$ 38,864	\$ 48,058
Short-term investments	122,236	9,997
Prepaid expenses and other current assets	4,194	3,014
Restricted cash	1,025	1,966
Total current assets	166,319	63,035
Property and equipment, net	10,068	6,778
Goodwill	21,359	21,359
Intangible assets, net	106,842	106,842
Deferred offering costs	—	511
Other assets	—	22
Total assets	<u>\$ 304,588</u>	<u>\$ 198,547</u>
Liabilities, Redeemable Convertible Preferred Stock and Stockholders' Equity (Deficit)		
Current liabilities:		
Accounts payable	\$ 3,111	\$ 4,594
Accrued expenses	5,806	5,888
Current portion of contingent consideration	—	1,296
Current portion of deferred revenue	1,042	—
Deferred rent	—	307
Total current liabilities	9,959	12,085
Long-term portion of contingent consideration	118,211	79,713
Deferred revenue, net of current portion	44,024	—
Deferred tax liabilities	913	6,039
Deferred rent, net of current portion	2,064	1,329
Total liabilities	175,171	99,166
Commitments and contingencies (Notes 3, 4 and 14)		
Redeemable convertible preferred stock (Series A, B and C), \$0.001 par value; no shares and 145,833,064 shares authorized as of September 30, 2018 and December 31, 2017, respectively; no shares and 142,288,292 shares issued and outstanding as of September 30, 2018 and December 31, 2017, respectively	—	192,896
Stockholders' equity (deficit):		
Preferred stock, \$0.001 par value; 10,000,000 shares and no shares authorized as of September 30, 2018 and December 31, 2017, respectively; no shares issued and outstanding as of September 30, 2018 and December 31, 2017	—	—
Common stock, \$0.001 par value; 200,000,000 shares and 236,092,611 shares authorized as of September 30, 2018 and December 31, 2017, respectively; 45,142,090 shares and 9,582,791 shares issued and outstanding as of September 30, 2018 and December 31, 2017, respectively	45	10
Additional paid-in capital	369,614	55,204
Accumulated deficit	(240,166)	(148,808)
Accumulated other comprehensive income (loss)	(76)	79
Total stockholders' equity (deficit)	129,417	(93,515)
Total liabilities, redeemable convertible preferred stock and stockholders' equity (deficit)	<u>\$ 304,588</u>	<u>\$ 198,547</u>

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

TRANSLATE BIO, INC.
CONDENSED CONSOLIDATED STATEMENTS OF OPERATIONS (UNAUDITED)
(In thousands, except share and per share amounts)

	Three Months Ended September 30,		Nine Months Ended September 30,	
	2018	2017	2018	2017
Collaboration revenue	\$ 238	\$ —	\$ 238	\$ —
Operating expenses:				
Research and development	12,933	11,097	40,854	34,224
General and administrative	5,957	3,607	16,726	9,706
Change in fair value of contingent consideration	26,829	6,132	39,589	10,731
Total operating expenses	45,719	20,836	97,169	54,661
Loss from operations	(45,481)	(20,836)	(96,931)	(54,661)
Other income (expense):				
Interest income	318	72	499	230
Other income (expense), net	(7)	—	(52)	59
Total other income (expense), net	311	72	447	289
Loss before benefit from income taxes	(45,170)	(20,764)	(96,484)	(54,372)
Benefit from income taxes	2,524	2,299	5,126	4,020
Net loss	(42,646)	(18,465)	(91,358)	(50,352)
Accretion of redeemable convertible preferred stock to redemption value	—	(180)	(644)	(539)
Net loss attributable to common stockholders	\$ (42,646)	\$ (18,645)	\$ (92,002)	\$ (50,891)
Net loss per share attributable to common stockholders—basic and diluted	\$ (0.97)	\$ (2.40)	\$ (5.13)	\$ (6.62)
Weighted average common shares outstanding—basic and diluted	44,036,206	7,781,398	17,949,026	7,682,179

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

TRANSLATE BIO, INC.
CONDENSED CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS (UNAUDITED)
(In thousands)

	<u>Three Months Ended September 30,</u>		<u>Nine Months Ended September 30,</u>	
	<u>2018</u>	<u>2017</u>	<u>2018</u>	<u>2017</u>
Net loss	\$ (42,646)	\$ (18,465)	\$ (91,358)	\$ (50,352)
Other comprehensive income (loss):				
Unrealized gains (losses) on available-for-sale securities, net of tax of \$0	(76)	33	(156)	110
Comprehensive loss	<u>\$ (42,722)</u>	<u>\$ (18,432)</u>	<u>\$ (91,514)</u>	<u>\$ (50,242)</u>

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

TRANSLATE BIO, INC.
CONDENSED CONSOLIDATED STATEMENTS OF CASH FLOWS (UNAUDITED)
(In thousands)

	Nine Months Ended September 30,	
	2018	2017
Cash flows from operating activities:		
Net loss	\$ (91,358)	\$ (50,352)
Adjustments to reconcile net loss to net cash used in operating activities:		
Depreciation and amortization expense	1,923	1,134
Stock-based compensation expense	5,693	1,303
Change in fair value of contingent consideration	39,589	10,731
Deferred income tax benefit	(5,126)	(4,020)
Accretion of discount on short-term investments	—	(95)
Changes in operating assets and liabilities, net of effects of acquisition:		
Prepaid expenses and other assets	(1,602)	(857)
Accounts payable	(1,593)	1,878
Accrued expenses	1,394	2,178
Deferred rent	429	582
Deferred revenue	44,762	—
Net cash used in operating activities	<u>(5,889)</u>	<u>(37,518)</u>
Cash flows from investing activities:		
Purchases of investments	(128,313)	(65,775)
Sales and maturities of investments	15,998	53,914
Purchases of property and equipment	(5,567)	(614)
Net cash used in investing activities	<u>(117,882)</u>	<u>(12,475)</u>
Cash flows from financing activities:		
Proceeds from initial public offering of common stock, net of underwriting discounts and commissions	117,447	—
Payments of initial public offering costs	(4,089)	—
Proceeds from option exercises	278	—
Net cash provided by financing activities	<u>113,636</u>	<u>—</u>
Net decrease in cash, cash equivalents and restricted cash	(10,135)	(49,993)
Cash, cash equivalents and restricted cash at beginning of period	50,024	58,761
Cash, cash equivalents and restricted cash at end of period	<u>\$ 39,889</u>	<u>\$ 8,768</u>
Cash, cash equivalents and restricted cash at end of period:		
Cash and cash equivalents	\$ 38,864	\$ 6,458
Restricted cash	1,025	2,310
Total cash, cash equivalents and restricted cash at end of period	<u>\$ 39,889</u>	<u>\$ 8,768</u>
Supplemental disclosure of non-cash investing and financing activities:		
Purchases of property and equipment included in accounts payable and accrued expenses	\$ 363	\$ 288
Deferred offering costs included in accounts payable and accrued expenses	\$ 13	\$ 40
Issuance of common stock in connection with acquisition of MRT Program (Note 4)	\$ 2,387	\$ —
Accretion of redeemable convertible preferred units and stock to redemption value	\$ 644	\$ 539

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

TRANSLATE BIO, INC.

NOTES TO CONDENSED CONSOLIDATED FINANCIAL STATEMENTS (UNAUDITED)

1. Nature of the Business and Basis of Presentation

Translate Bio, Inc. (the “Company”) is a clinical-stage messenger RNA (“mRNA”) therapeutics company developing a new class of potentially transformative medicines to treat diseases caused by protein or gene dysfunction. Using its proprietary mRNA therapeutic platform (“MRT platform”), the Company creates mRNA that encodes functional proteins. The Company’s mRNA is delivered to the target cell where the cell’s own machinery recognizes it and translates it, restoring or augmenting protein function to treat or prevent disease. The Company is initially focused on restoring the expression of intracellular and transmembrane proteins, areas that have eluded conventional protein therapeutics, in patients with genetic diseases where there is high unmet medical need. The Company is developing its lead MRT product candidate for the lung (“MRT5005”) for the treatment of cystic fibrosis (“CF”). The Company is developing its lead MRT product candidate for the liver (“MRT5201”) for the treatment of ornithine transcarbamylase (“OTC”) deficiency.

In December 2016, the Company acquired from Shire Human Genetic Therapies, Inc. (“Shire”), a subsidiary of Shire plc, rights to the assets of Shire’s mRNA therapy platform (the “MRT Program”), including the cystic fibrosis transmembrane conductance regulator (“CFTR”) and OTC deficiency mRNA therapy programs. In connection with this acquisition, Shire received shares of the Company’s common stock, with related anti-dilution rights, and is eligible for future milestone and earnout payments on products developed with the MRT technology (see Note 4).

The Company is subject to risks common to early-stage companies in the biotechnology industry, including, but not limited to, development by competitors of new technological innovations, dependence on key personnel, protection of proprietary technology, compliance with government regulations and the ability to secure additional capital to fund operations. Product candidates currently under development will require significant additional research and development efforts, including preclinical and clinical testing and regulatory approval, prior to commercialization. These efforts require significant amounts of additional capital, adequate personnel and infrastructure and extensive compliance-reporting capabilities. Even if the Company’s product development efforts are successful, it is uncertain when, if ever, the Company will realize significant revenue from product sales.

The accompanying condensed consolidated financial statements have been prepared in accordance with accounting principles generally accepted in the United States of America (“GAAP”) and include the accounts of the Company and its two wholly owned subsidiaries, Translate Bio MA, Inc. and Translate Bio Securities Corporation, from their date of incorporation. All intercompany accounts and transactions have been eliminated in consolidation.

Reverse Stock Split

On June 15, 2018, the Company effected a one-for-5.5555 reverse stock split of its issued and outstanding shares of common stock and a proportional adjustment to the existing conversion ratios for each series of the Company’s redeemable convertible preferred stock (see Note 8). Accordingly, all share and per share amounts for all periods presented in the accompanying condensed consolidated financial statements and notes thereto have been adjusted retroactively, where applicable, to reflect this reverse stock split and the associated adjustment of the preferred stock conversion ratios.

Initial Public Offering

On June 27, 2018, the Company’s registration statement on Form S-1 relating to its initial public offering of its common stock (“the IPO”) was declared effective by the Securities and Exchange Commission (“SEC”). In the IPO, which closed on July 2, 2018, the Company issued and sold 9,350,000 shares of common stock at a public offering price of \$13.00 per share. On July 24, 2018, the Company issued and sold an additional 364,371 shares of common stock at a price of \$13.00 per share pursuant to the exercise of the underwriters’ over-allotment option in the IPO. The aggregate net proceeds to the Company from the IPO, inclusive of the proceeds from the over-allotment exercise, were \$113.2 million after deducting underwriting discounts and commissions of \$8.8 million and offering expenses of \$4.3 million. Upon closing of the IPO, all 142,288,292 shares of the Company’s redeemable convertible preferred stock then outstanding converted into an aggregate of 25,612,109 shares of common stock.

Sanofi Pasteur Collaboration and Licensing Agreement

On June 8, 2018, the Company entered into a collaboration and license agreement with Sanofi Pasteur Inc. (“Sanofi”), the vaccines global business unit of Sanofi S.A., to develop mRNA vaccines for up to five undisclosed infectious disease pathogens (the “Sanofi Agreement”). The Sanofi Agreement became effective on July 9, 2018, following notice of early termination of the waiting period under the Hart-Scott-Rodino Antitrust Act of 1976. Under the Sanofi Agreement, the Company and Sanofi will jointly conduct research and development activities to advance mRNA vaccines and mRNA vaccine platform development during a three-year research term, which may be extended by mutual agreement. Following the research term, the Company is obligated to manufacture clinical product for Sanofi, which the Company estimates may take up to eight years to complete.

The Company is eligible to receive up to \$805.0 million in payments, which includes an upfront payment of \$45.0 million, which the Company received in July 2018; certain development, regulatory and sales-related milestones across several vaccine targets; and option exercise fees if Sanofi exercises its option related to development of vaccines for additional pathogens. The Company is also eligible to receive tiered royalty payments associated with worldwide sales of the developed vaccines, if any (see Note 3).

Going Concern

In accordance with Accounting Standards Update (“ASU”) No. 2014-15, *Disclosure of Uncertainties about an Entity’s Ability to Continue as a Going Concern (Subtopic 205-40)*, the Company has evaluated whether there are conditions and events, considered in the aggregate, that raise substantial doubt about the Company’s ability to continue as a going concern within one year after the date that the consolidated financial statements are issued.

The Company’s financial statements have been prepared on the basis of continuity of operations, realization of assets and the satisfaction of liabilities in the ordinary course of business. Through September 30, 2018, the Company has funded its operations with proceeds from the sale of redeemable convertible preferred stock and the sale of bridge units, which ultimately converted into shares of our preferred stock, the proceeds from our IPO and an upfront payment received under the Sanofi Agreement. The Company has incurred recurring losses since its inception, including net losses of \$91.4 million and \$50.4 million for the nine months ended September 30, 2018 and 2017, respectively. In addition, the Company had an accumulated deficit of \$240.2 million as of September 30, 2018. The Company expects to continue to generate operating losses for the foreseeable future.

As of November 8, 2018, the date of issuance of these unaudited interim condensed financial statements, the Company expects that its cash, cash equivalents and short-term investments of \$161.1 million as of September 30, 2018 will be sufficient to fund its operating expenses and capital expenditure requirements into the first half of 2020.

If the Company is unable to obtain funding, the Company will be forced to delay, reduce or eliminate some or all of its research and development programs, product portfolio expansion or commercialization efforts, which could adversely affect its business prospects, or the Company may be unable to continue operations. Although management continues to pursue these plans, there is no assurance that the Company will be successful in obtaining sufficient funding on terms acceptable to the Company to fund continuing operations, if at all.

2. Summary of Significant Accounting Policies

Use of Estimates

The preparation of the Company’s consolidated financial statements in conformity with GAAP requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities, the disclosure of contingent assets and liabilities at the date of the consolidated financial statements, and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates. Significant estimates and assumptions reflected in these consolidated financial statements include, but are not limited to, the accrual for research and development expenses, the revenue recognized from collaboration agreements, the valuation of common stock and stock-based awards, the valuation of assets acquired and liabilities assumed in business combinations, and the impairment of identifiable intangible assets and goodwill. Estimates are periodically reviewed in light of changes in circumstances, facts and experience. Changes in estimates are recorded in the period in which they become known. Actual results could differ from those estimates.

Unaudited Interim Financial Information

The accompanying unaudited condensed consolidated balance sheet as of September 30, 2018, the unaudited condensed consolidated statements of operations and of comprehensive loss for the three and nine months ended September 30, 2018 and 2017 and of the unaudited condensed consolidated statements of cash flows for the nine months ended September 30, 2018 and 2017 have been prepared by the Company, pursuant to the rules and regulations of the SEC for interim financial statements. Certain information and footnote disclosures normally included in financial statements prepared in accordance with GAAP have been condensed or omitted pursuant to rules and regulations. However, the Company believes that the disclosures are adequate to make the information presented not misleading. The accompanying unaudited interim condensed consolidated financial statements should be read in conjunction with the Company's audited consolidated financial statements and the notes thereto for the year ended December 31, 2017 included in the Company's prospectus that forms a part of the Company's Registration Statement on Form S-1 (File No. 333-225368). The prospectus was filed with the SEC pursuant to Rule 424(b)(4) on June 29, 2018.

The accompanying unaudited interim condensed consolidated financial presentation has been prepared on the same basis as the audited annual consolidated financial statements and, in the opinion of management, reflect all adjustments, which include only normal recurring adjustments, necessary for the fair statement of the Company's financial position as of September 30, 2018, the results of its operations for the three and nine months ended September 30, 2018 and 2017, and its cash flows for the nine months ended September 30, 2018 and 2017. The financial data and other information disclosed in these notes related to the three and nine months ended September 30, 2018 and 2017 are also unaudited. The results for the nine months ended September 30, 2018 are not necessarily indicative of results to be expected for the year ending December 31, 2018, any other interim periods, or any future year or period.

Cash and Cash Equivalents

All highly liquid investments purchased with an original maturity date of three months or less at the date of purchase are considered to be cash equivalents. Cash equivalents consisted of money market funds as of September 30, 2018 and December 31, 2017.

Investments

The Company's debt security investments are classified as available-for-sale and are carried at fair value, with the unrealized gains and losses reported as a component of accumulated other comprehensive income (loss) in stockholders' equity (deficit). Realized gains and losses and declines in value determined to be other than temporary are based on the specific identification method and are included as a component of other income (expense), net in the consolidated statements of operations.

The Company evaluates its investments with unrealized losses for other-than-temporary impairment. When assessing investments for other-than-temporary declines in value, the Company considers such factors as, among other things, how significant the decline in value is as a percentage of the original cost, how long the market value of the investment has been less than its original cost, the Company's ability and intent to retain the investment for a period of time sufficient to allow for any anticipated recovery in fair value and market conditions in general. If any adjustment to fair value reflects a decline in the value of the investment that the Company considers to be "other than temporary," the Company reduces the investment to fair value through a charge to the statement of operations. No such adjustments were necessary during the periods presented.

The Company's investments as of September 30, 2018 and December 31, 2017 had original maturities of less than one year.

Concentrations of Credit Risk

Financial instruments that potentially subject the Company to concentrations of credit risk consist principally of cash and cash equivalents as well as short-term investments. Cash, cash equivalents and short-term investments consist of demand deposits, money market funds and U.S. government agency bonds. The Company generally maintains balances in various operating accounts with financial institutions that management believes to be of high credit quality, in amounts that may exceed federally insured limits. The Company has not experienced any losses related to its cash, cash equivalents and short-term investments and does not believe that it is subject to unusual credit risk beyond the normal credit risk associated with commercial banking relationships.

Restricted Cash

In connection with its operating lease commitments, the Company issued letters of credit collateralized by cash deposits that are classified as restricted cash in the consolidated balance sheets. Restricted cash amounts have been classified as current assets based on the release dates of the restrictions under the letters of credit, which occur annually.

Deferred Offering Costs

The Company capitalizes certain legal, professional accounting and other third-party fees that are directly associated with in-process equity financings as deferred offering costs until such financings are consummated. After consummation of the equity financing, these costs are recorded in stockholders' equity (deficit) as a reduction of proceeds generated as a result of the offering. Should an in-process equity financing be abandoned, the deferred offering costs will be expensed immediately as a charge to operating expenses in the consolidated statements of operations. As of September 30, 2018 and December 31, 2017, the Company recorded deferred offering costs of \$0 and \$0.5 million, respectively, in connection with its IPO.

Property and Equipment

Property and equipment are stated at cost less accumulated depreciation and amortization. Depreciation and amortization expense is recognized using the straight-line method over the estimated useful lives of each asset. Estimated useful lives are periodically assessed to determine if changes are appropriate. Upon retirement or sale, the related cost and accumulated depreciation and amortization are removed from the accounts and any resulting gain or loss is included in the consolidated statements of operations. Repair and maintenance costs are expensed as incurred. The estimated useful lives of the Company's property and equipment are as follows:

	Estimated Useful Life
Laboratory equipment	5 years
Computer equipment	3 years
Office equipment	5 years
Leasehold improvements	Shorter of lease term or 10 years

Costs for capital assets not yet placed into service are capitalized as construction-in-progress and depreciated or amortized in accordance with the above useful lives once placed into service.

Property and equipment are tested for recoverability whenever events or changes in business circumstances indicate that the carrying amount of the assets may not be fully recoverable. Factors that the Company considers in deciding when to perform an impairment review include significant underperformance of the business in relation to expectations, significant negative industry or economic trends and significant changes or planned changes in the use of the assets. If an impairment review is performed to evaluate an asset group for recoverability, the Company compares the forecasted undiscounted cash flows expected to result from the use and eventual disposition of the asset group to its carrying value. An impairment loss would be recognized when estimated undiscounted future cash flows expected to result from the use and eventual disposition of an asset group are less than its carrying amount. The impairment loss would be based on the excess of the carrying value of the impaired asset group over its fair value, determined based on discounted cash flows using market participant assumptions. The Company did not record any impairment losses on property and equipment during the three and nine months ended September 30, 2018 and 2017.

Revenue Recognition

The terms of the Company's collaboration agreements may include consideration such as non-refundable license fees, funding of research and development services, payments due upon the achievement of clinical and pre-clinical performance-based development milestones, regulatory milestones, manufacturing services, sales-based milestones and royalties on product sales.

The Company had no revenue prior to the Sanofi Agreement, therefore the adoption of the new revenue recognition standard, described further in Note 3 under the heading "Accounting under ASC 606", had no impact to the Company. The new revenue recognition standard applies to all contracts with customers, except for contracts that are within the scope of other standards, such as leases, insurance, collaboration arrangements and financial instruments. The new revenue recognition standard provides a five-step framework whereby revenue is recognized when control of promised goods or services is transferred to a customer at an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services. To determine revenue recognition for arrangements that the Company determines are within the scope of the new revenue standard, the Company performs the following five steps: (i) identify the promised goods or services in the contract; (ii) determine whether the promised goods or services are performance obligations including whether they are distinct in the context of the contract; (iii) measure the transaction price, including the constraint on variable consideration; (iv) allocate the transaction price to the performance obligations; and (v) recognize revenue when (or as) the Company satisfies each performance obligation. The Company only applies the five-step model to contracts when collectability of the consideration to which the Company is entitled in exchange for the goods or services the Company transfers to the customer is determined to be probable. At contract inception, once the contract is determined to be within the scope of the new revenue standard, the Company assesses whether the goods or services promised within each contract are distinct and, therefore, represent a separate performance obligation. Goods and services that are determined not to be distinct are combined with

other promised goods and services until a distinct bundle is identified. The Company then allocates the transaction price (the amount of consideration the Company expects to be entitled to from a customer in exchange for the promised goods or services) to each performance obligation and recognizes the associated revenue when (or as) each performance obligation is satisfied. The Company's estimate of the transaction price for each contract includes all variable consideration to which the Company expects to be entitled.

The Company recognizes the transaction price allocated to upfront license payments as revenue upon delivery of the license to the customer and resulting ability of the customer to use and benefit from the license, if the license is determined to be distinct from the other performance obligations identified in the contract. If the license is considered to not be distinct from other performance obligations, the Company utilizes judgment to assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied (i) at a point in time, but only for licenses determined to be distinct from other performance obligations in the contract, or (ii) over time; and, if over time, the appropriate method of measuring progress for purposes of recognizing revenue from license payments. The Company evaluates the measure of progress each reporting period and, if necessary, adjusts the measure of performance and related revenue recognition.

The Sanofi Agreement entitles the Company to additional payments upon the achievement of performance-based milestones. These milestones are generally categorized into three types: development milestones, generally based on the advancement of the Company's pipeline and initiation of clinical trials; regulatory milestones, generally based on the submission, filing or approval of regulatory applications such as a New Drug Application ("NDA"), in the United States; and sales-based milestones, generally based on meeting specific thresholds of sales in certain geographic areas. The Company is also eligible to receive from Sanofi tiered royalty payments on worldwide net sales of mRNA vaccines. For each collaboration that includes development milestone payments, the Company evaluates whether it is probable that the consideration associated with each milestone will not be subject to a significant reversal in the cumulative amount of revenue recognized. Amounts that meet this threshold are included in the transaction price using the most likely amount method, whereas amounts that do not meet this threshold are considered constrained and excluded from the transaction price until they meet this threshold. Milestones tied to regulatory approval, and therefore not within the Company's control, are considered constrained until such approval is received. Upfront and ongoing development milestones per its collaboration agreements are not subject to refund if the development activities are not successful. At the end of each subsequent reporting period, the Company re-evaluates the probability of a significant reversal of the cumulative revenue recognized for the milestones, and, if necessary, adjusts the estimate of the overall transaction price. Any such adjustments are recorded on a cumulative catch-up basis, which would affect revenues from collaborators in the period of adjustment. The Company excludes sales-based milestone payments and royalties from the transaction price until the sale occurs (or, if later, until the underlying performance obligation to which some or all of the royalty has been allocated, has been satisfied, or partially satisfied), because the license to the Company's intellectual property is deemed to be the predominant item to which the royalties relate as it is the primary driver of value. Currently, the Company has not recognized any royalty revenue resulting from the Sanofi Agreement.

The new revenue recognition standard requires the Company to allocate the arrangement consideration on a relative standalone selling price basis for each performance obligation after determining the transaction price of the contract and identifying the performance obligations to which that amount should be allocated. The relative standalone selling price is defined in the new revenue recognition standard as the price at which an entity would sell a promised good or service separately to a customer. If other observable transactions in which the Company has sold the same performance obligation separately are not available, the Company is required to estimate the standalone selling price of each performance obligation. Key assumptions to determine the standalone selling price may include forecasted revenues, development timelines, reimbursement rates for personnel costs, discount rates and probabilities of technical and regulatory success.

Whenever the Company determines that a contract should be accounted for as a combined performance obligation it will utilize the input method. Revenue will be recognized using the input method, based on the total estimated costs to fulfill the obligations, as services are delivered (expenses incurred over the total budgeted amount). Significant management judgment is required in determining the level of effort required under an arrangement and the period over which the Company is expected to complete its performance obligations under an arrangement.

The Company evaluates its collaborative agreements for proper classification in the consolidated statements of operations based on the nature of the underlying activity. Transactions between collaborators recorded in the Company's consolidated statements of operations are recorded on either a gross or net basis, depending on the characteristics of the collaborative relationship.

For revenue generating arrangements where the Company, as a vendor, provides consideration to a licensor or collaborator, as a customer, the Company applies the accounting standard that governs such transactions. This standard addresses the accounting for revenue arrangements where both the vendor and the customer make cash payments to each other for services and/or products. A payment to a customer is presumed to be a reduction of the transaction price unless the Company receives an identifiable benefit for the payment and it can reasonably estimate the fair value of the benefit received. Payments to a customer that are deemed a reduction of the transaction price are recorded first as a reduction of revenue, to the extent of both cumulative revenue recorded to date and

probable future revenues, which include any unamortized deferred revenue balances, under all arrangements with such customer, and then as an expense. Payments that are not deemed to be a reduction of the transaction price are recorded as an expense.

Consideration that does not meet the requirements to satisfy the above revenue recognition criteria is a contract liability and is recorded as deferred revenue in the condensed consolidated balance sheets. Although the Company follows detailed guidelines in measuring revenue, certain judgments affect the application of its revenue policy. For example, in connection with the Sanofi Agreement, the Company has recorded short-term and long-term deferred revenue on its condensed consolidated balance sheets based on the Company's best estimate of when such revenue will be recognized. Short-term deferred revenue consists of amounts that are expected to be recognized as revenue in the next 12 months. Amounts that the Company expects will not be recognized within the next 12 months are classified as long-term deferred revenue.

The estimate of deferred revenue also reflects management's estimate of the periods of the Company's involvement in certain of its collaborations. The Company's performance obligations under these collaborations consist of participation on steering committees and the performance of other research and development services. In certain instances, the timing of satisfying these obligations can be difficult to estimate. Accordingly, the Company's estimates may change in the future. Such changes to estimates would result in a change in revenue recognition amounts. If these estimates and judgments change over the course of these agreements, it may affect the timing and amount of revenue that the Company will recognize and record in future periods. At September 30, 2018, the Company had short-term and long-term deferred revenue of \$1.0 million and \$44.0 million, respectively, related to the Sanofi Agreement.

Under the new revenue recognition standard, the Company will recognize revenue and record a receivable when it fulfills its performance obligations under the Sanofi Agreement. When no further performance obligation is required to be satisfied, the Company will recognize revenue for the portion satisfied and record a receivable. Amounts are recorded as accounts receivable when the Company's right to consideration is unconditional. A contract liability is recognized when a customer prepays consideration or owes prepayment to an entity according to a contract. The Company does not assess whether a contract has a significant financing component if the expectation at contract inception is that the period between payment by the customer and the transfer of the promised goods or services to the customer will be one year or less. The Company expenses incremental costs of obtaining a contract as and when incurred if the expected amortization period of the asset that the Company would have recognized is one year or less or the amount is immaterial. At September 30, 2018, the Company has not capitalized any costs to obtain any of its contracts.

Business Combinations

The Company accounts for business combinations using the acquisition method of accounting. Application of this method of accounting requires that (i) identifiable assets acquired (including identifiable intangible assets) and liabilities assumed generally be measured and recognized at fair value as of the acquisition date and (ii) the excess of the purchase price over the net fair value of identifiable assets acquired and liabilities assumed be recognized as goodwill, which is not amortized for accounting purposes but is subject to testing for impairment at least annually. Acquired in-process research and development ("IPR&D") is recognized at fair value and initially characterized as an indefinite-lived intangible asset, irrespective of whether the acquired IPR&D has an alternative future use. Transaction costs related to business combinations are expensed as incurred.

Determining the fair value of assets acquired and liabilities assumed in a business combination requires management to use significant judgment and estimates, especially with respect to intangible assets. Critical estimates in valuing certain identifiable assets include, but are not limited to, the selection of valuation methodologies, estimates of future revenue and cash flows, expected long-term market growth, future expected operating expenses, costs of capital and appropriate discount rates. Management's estimates of fair value are based upon assumptions believed to be reasonable, but which are inherently uncertain and, as a result, actual results may differ materially from estimates.

During the measurement period, which extends no later than one year from the acquisition date, the Company may record certain adjustments to the carrying value of the assets acquired and liabilities assumed with the corresponding offset to goodwill. After the measurement period, all adjustments are recorded in the consolidated statements of operations as operating expenses or income.

Acquisition-related contingent consideration, which consists of potential milestone and earnout payment obligations as well as anti-dilution rights provided to Shire (see Note 4), was recorded in the consolidated balance sheets at its acquisition-date estimated fair value, in accordance with the acquisition method of accounting. The fair value of the acquisition-related contingent consideration is remeasured each reporting period, with changes in fair value recorded in the consolidated statements of operations. The fair value measurement is based on significant inputs not observable by market participants and thus represents a Level 3 input in the fair value hierarchy (see Note 5).

Asset Acquisitions

The Company measures and recognizes asset acquisitions that are not deemed to be business combinations based on the cost to acquire the assets, which includes transaction costs. Goodwill is not recognized in asset acquisitions. In an asset acquisition, the cost allocated to acquire IPR&D with no alternative future use is charged to expense at the acquisition date.

In-Process Research and Development

The fair value of IPR&D acquired through a business combination is capitalized as an indefinite-lived intangible asset until the completion or abandonment of the related research and development activities. When the related research and development is completed or a change in circumstance occurs that defines the useful life, the asset is reclassified to a definite-lived asset and amortized over its estimated useful life. When a change between these classes occurs, the Company will perform an impairment test.

The fair value of an IPR&D intangible asset is typically determined using an income approach whereby management forecasts the net cash flows expected to be generated by the asset over its estimated useful life. The net cash flows reflect the asset's stage of completion, the probability of technical success, the projected costs to complete, expected market competition, and an assessment of the asset's life-cycle. The net cash flows are then adjusted to present value by applying an appropriate discount rate that reflects the risk factors associated with the cash flow streams.

Indefinite-lived IPR&D is not subject to amortization, but is tested annually for impairment or more frequently if there are indicators of impairment. The Company tests its indefinite-lived IPR&D annually for impairment on October 1st. In testing indefinite-lived IPR&D for impairment, the Company has the option to first assess qualitative factors to determine whether the existence of events or circumstances would indicate that it is more likely than not that its fair value is less than its carrying amount, or the Company can perform a quantitative impairment analysis to determine the fair value of the indefinite-lived IPR&D without performing a qualitative assessment. Qualitative factors that the Company considers include significant underperformance of the business in relation to expectations, significant negative industry or economic trends and significant changes or planned changes in the use of the assets. If the Company chooses to first assess qualitative factors and the Company determines that it is more likely than not that the fair value of the indefinite-lived IPR&D is less than its carrying amount, the Company would then determine the fair value of the indefinite-lived IPR&D. Under either approach, if the fair value of the indefinite-lived IPR&D is less than its carrying amount, an impairment charge is recognized in the consolidated statements of operations. During the three and nine months ended September 30, 2018 and 2017, the Company did not recognize any impairment charges related to its indefinite-lived IPR&D (see Note 4).

Definite-lived IPR&D, if any, is tested for recoverability whenever events or changes in business circumstances indicate that the carrying amount of the assets may not be fully recoverable. If an impairment review is performed to evaluate an asset group for recoverability, the Company compares the forecasted undiscounted cash flows expected to result from the use and eventual disposition of the asset group to its carrying value. An impairment loss would be recognized when estimated undiscounted future cash flows expected to result from the use and eventual disposition of an asset group are less than its carrying amount. The impairment loss would be based on the excess of the carrying value of the impaired asset group over its fair value, determined based on discounted cash flows using market participant assumptions.

Goodwill

Goodwill represents the excess of the fair value of the consideration transferred over the fair value of the net tangible and identifiable intangible assets acquired in a business combination. Goodwill is not subject to amortization, but is tested annually for impairment or more frequently if there are indicators of impairment. The Company tests its goodwill annually for impairment on October 1st.

The Company has determined that there is a single reporting unit for purposes of testing goodwill for impairment. In testing goodwill for impairment, the Company has the option to first assess qualitative factors to determine whether the existence of events or circumstances would indicate that it is more likely than not that the fair value of the reporting unit was less than its carrying amount, or the Company can perform a two-step quantitative impairment analysis without performing a qualitative assessment. Examples of such events or circumstances considered in the Company's qualitative assessment include, but are not limited to, a significant adverse change in legal or business climate, an adverse regulatory action or unanticipated competition. If the Company chooses to first assess qualitative factors and the Company determines that it is more likely than not that the fair value of its reporting unit is less than its carrying amount, the Company would then perform a two-step quantitative impairment test. The two-step test starts with comparing the fair value of the reporting unit to the carrying amount of a reporting unit, including goodwill. If the fair value of the reporting unit exceeds the carrying amount, no impairment loss is recognized. However, if the fair value of the reporting unit is less than its carrying value, the second step of the impairment test is performed to determine if goodwill is impaired. If the Company determines that goodwill is impaired, the carrying value of the goodwill is written down to its fair value and an impairment charge is recognized in the consolidated statements of operations. During the three and nine months ended September 30, 2018 and 2017, the Company did not recognize any impairment charges related to goodwill.

Fair Value Measurements

Certain assets and liabilities of the Company are carried at fair value under GAAP. Fair value is defined as the exchange price that would be received for an asset or paid to transfer a liability (an exit price) 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. Financial assets and liabilities carried at fair value are to be classified and disclosed in one of the following three levels of the fair value hierarchy, of which the first two are considered observable and the last is considered unobservable:

- Level 1—Quoted prices in active markets for identical assets or liabilities.
- Level 2—Observable inputs (other than Level 1 quoted prices), such as quoted prices in active markets for similar assets or liabilities, quoted prices in markets that are not active for identical or similar assets or liabilities, or other inputs that are observable or can be corroborated by observable market data.
- Level 3—Unobservable inputs that are supported by little or no market activity that are significant to determining the fair value of the assets or liabilities, including pricing models, discounted cash flow methodologies and similar techniques.

The Company's cash equivalents and short-term investments are carried at fair value, determined based on Level 2 inputs in the fair value hierarchy described above (see Note 5). The Company's contingent consideration liability is carried at fair value, determined based on Level 3 inputs in the fair value hierarchy described above (see Note 5). The carrying values of the Company's prepaid expenses and other current assets, accounts payable, accrued expenses and other short-term liabilities approximate their fair values due to the short-term nature of these assets and liabilities.

Segment Information

The Company manages its operations as a single operating segment for the purposes of assessing performance and making operating decisions. The Company's primary focus is on the advancement of the Company's MRT platform to treat diseases caused by protein or gene dysfunction.

Research and Development Costs

Costs associated with internal research and development and external research and development services, including drug development and preclinical studies, are expensed as incurred. Research and development expenses include costs for salaries, employee benefits, subcontractors, facility-related expenses, depreciation and amortization, stock-based compensation, third-party license fees, laboratory supplies, and external costs of outside vendors engaged to conduct discovery, preclinical and clinical development activities and clinical trials as well as to manufacture clinical trial materials, and other costs. The Company recognizes external research and development costs based on an evaluation of the progress to completion of specific tasks using information provided to the Company by its service providers. Nonrefundable advance payments for goods or services to be received in the future for use in research and development activities are recorded as prepaid expenses. Such prepaid expenses are recognized as an expense when the services have been performed or the goods have been delivered, or when it is no longer expected that the goods will be delivered or the services rendered.

Upfront payments, milestone payments (other than those deemed contingent consideration in a business combination) and annual maintenance fees under license agreements are expensed in the period in which they are incurred.

Research and Development Contract Costs and Accruals

The Company has entered into various research and development-related contracts with companies both inside and outside of the United States. The related costs are recorded as research and development expenses as incurred. The Company records accruals for estimated ongoing research and development costs. When evaluating the adequacy of the accrued liabilities, the Company analyzes progress of the studies or clinical trials, including the phase or completion of events, invoices received and contracted costs. Significant judgments and estimates are made in determining the accrued balances at the end of any reporting period. Actual results could differ materially from the Company's estimates. The Company's historical accrual estimates have not been materially different from the actual costs.

Stock-Based Compensation

The Company measures all stock-based awards granted to employees and directors based on their fair value on the date of the grant and recognizes compensation expense for those awards over the requisite service period, which is generally the vesting period of the respective award. For stock-based awards with service-based vesting conditions, the Company recognizes compensation expense using the straight-line method. For stock-based awards with both performance-based and service-based vesting conditions, the Company recognizes compensation expense using the graded-vesting method over the requisite service period, commencing when achievement of the performance condition becomes probable. The fair value of each stock option grant is estimated on the date of grant using the Black-Scholes option-pricing model, which requires inputs based on certain subjective assumptions, including the

expected stock price volatility, the expected term of the option, the risk-free interest rate for a period that approximates the expected term of the option, and the Company's expected dividend yield (see Note 11). The fair value of each restricted common stock award is estimated on the date of grant based on the fair value of the Company's common stock on that same date.

For stock-based awards granted to non-employee consultants, compensation expense is recognized over the period during which services are rendered by such non-employee consultants until completed. At the end of each financial reporting period prior to completion of the service, the fair value of these awards is remeasured using the then-current fair value of the Company's common stock and updated assumption inputs in the Black-Scholes option-pricing model.

The Company classifies stock-based compensation expense in its consolidated statements of operations in the same manner in which the award recipient's payroll costs are classified or in which the award recipient's service payments are classified.

Classification and Accretion of Redeemable Convertible Preferred Stock

The Company has classified its redeemable convertible preferred stock outside of stockholders' equity (deficit) because the shares contain certain redemption features that are not solely within the control of the Company. Costs incurred in connection with the issuance of each series of redeemable convertible preferred stock are recorded as a reduction of gross proceeds from issuance. The carrying values of redeemable convertible preferred stock are accreted to their redemption values through a charge to additional paid-in capital or accumulated deficit over the period from date of issuance to the earliest date on which the holders could, at their option, elect to redeem their shares.

Comprehensive Loss

Comprehensive loss includes net loss as well as other changes in stockholders' equity (deficit) that result from transactions and economic events other than those with stockholders. The Company's only element of other comprehensive income (loss) was unrealized gains (losses) on U.S. government agency bonds, which are classified as available-for-sale-securities.

Income Taxes

The Company accounts for income taxes using the asset and liability method, which requires the recognition of deferred tax assets and liabilities for the expected future tax consequences of events that have been recognized in the consolidated financial statements or in the Company's tax returns. Deferred tax assets and liabilities are determined on the basis of the differences between the financial statement and tax basis of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to reverse. Changes in deferred tax assets and liabilities are recorded in the provision for income taxes. The Company assesses the likelihood that its deferred tax assets will be recovered from future taxable income and, to the extent it believes, based upon the weight of available evidence, that it is more likely than not that all or a portion of the deferred tax assets will not be realized, a valuation allowance is established through a charge to income tax expense. Potential for recovery of deferred tax assets is evaluated by estimating the future taxable profits expected and considering prudent and feasible tax planning strategies.

The Company accounts for uncertainty in income taxes recognized in the consolidated financial statements by applying a two-step process to determine the amount of tax benefit to be recognized. First, the tax position must be evaluated to determine the likelihood that it will be sustained upon external examination by the taxing authorities. If the tax position is deemed more-likely-than-not to be sustained, the tax position is then assessed to determine the amount of benefit to recognize in the consolidated financial statements. The amount of the benefit that may be recognized is the largest amount that has a greater than 50% likelihood of being realized upon ultimate settlement. The provision for income taxes includes the effects of any resulting tax reserves, or unrecognized tax benefits, that are considered appropriate as well as the related net interest and penalties.

Net Income (Loss) per Share

The Company follows the two-class method when computing net income (loss) per share as the Company has issued shares that meet the definition of participating securities. The two-class method determines net income (loss) per share for each class of common and participating securities according to dividends declared or accumulated and participation rights in undistributed earnings. The two-class method requires income available to common stockholders for the period to be allocated between common and participating securities based upon their respective rights to receive dividends as if all income for the period had been distributed.

Basic net income (loss) per share attributable to common stockholders is computed by dividing the net income (loss) attributable to common stockholders by the weighted average number of shares of common stock outstanding for the period. Diluted net income (loss) attributable to common stockholders is computed by adjusting net income (loss) attributable to common stockholders to reallocate undistributed earnings based on the potential impact of dilutive securities. Diluted net income (loss) per share attributable to common stockholders is computed by dividing the diluted net income (loss) attributable to common stockholders by the weighted

average number of shares of common stock outstanding for the period, including potential dilutive shares of common stock. For purpose of this calculation, outstanding stock options, unvested restricted common stock and redeemable convertible preferred stock are considered potential dilutive shares of common stock.

The Company's preferred stock contractually entitles the holders of such shares to participate in dividends but does not contractually require the holders of such shares to participate in losses of the Company. Accordingly, in periods in which the Company reports a net loss attributable to common stockholders, such losses are not allocated to such participating securities. In periods in which the Company reports a net loss attributable to common stockholders, diluted net loss per share attributable to common stockholders is the same as basic net loss per share attributable to common stockholders, since dilutive shares of common stock are not assumed to have been issued if their effect is anti-dilutive. The Company reported a net loss attributable to common stockholders for the three and nine months ended September 30, 2018 and 2017.

Recently Adopted Accounting Pronouncements

In August 2016, the Financial Accounting Standards Board ("FASB") issued ASU No. 2016-15, *Statement of Cash Flows: Classification of Certain Cash Receipts and Cash Payments (Topic 230)* ("ASU 2016-15"), to address diversity in practice in how certain cash receipts and cash payments are presented in the statement of cash flows. The adoption of ASU 2016-15 is required to be applied retrospectively. The Company adopted ASU 2016-15 as of the required effective date of January 1, 2018, and its adoption had no impact on the Company's financial position, results of operations or cash flows.

In November 2016, the FASB issued ASU No. 2016-18, *Statement of Cash Flows (Topic 230)* ("ASU 2016-18"), which requires that amounts generally described as restricted cash and restricted cash equivalents should be included with cash and cash equivalents when reconciling the beginning-of-period and end-of-period total amounts shown on the statement of cash flows. The Company adopted ASU 2016-18 as of the required effective date of January 1, 2018. The effect of the adoption was that the amount of cash and cash equivalents previously presented on the consolidated statements of cash flows for the nine months ended September 30, 2017 increased by \$2.3 million to reflect the inclusion of restricted cash. Additionally, as a result of the adoption, transfers between restricted and unrestricted cash are no longer presented as a component of the Company's investing activities.

In May 2017, the FASB issued ASU No. 2017-09, *Compensation—Stock Compensation: Scope of Modification Accounting (Topic 718)* ("ASU 2017-09"), which clarifies when to account for a change to the terms or conditions of a share-based payment award as a modification. Under the new guidance, modification accounting is required only if the fair value, the vesting conditions or the classification of the award (as equity or liability) changes as a result of the change in terms or conditions. The Company adopted ASU 2017-09 as of the required effective date of January 1, 2018, and its adoption had no impact on the Company's financial position, results of operations or cash flows.

Recently Issued Accounting Pronouncements

In February 2016, the FASB issued ASU No. 2016-02, *Leases (Topic 842)* ("ASU 2016-02"). ASU 2016-02 requires lessees to recognize most leases on their balance sheet as a right-of-use asset and a lease liability. Leases will be classified as either finance or operating, with classification affecting the pattern of expense recognition in the income statement. Leases with a term of 12 months or less will be accounted for similar to existing guidance for operating leases today. The guidance is effective for public entities for annual periods beginning after December 15, 2018 and for interim periods within those fiscal years. The Company will adopt ASU 2016-02 effective as of January 1, 2019. In July 2018, the FASB issued ASU No. 2018-11, *Leases (Topic 842) – Targeted Improvements*, ("ASU 2018-11"), which includes certain amendments to ASU 2016-02 intended to provide relief in implementing the new standard. Among these amendments is the option to not restate comparative periods presented in the financial statements. The Company intends to elect this new transition approach, using a cumulative-effect adjustment on the effective date of the standard, with comparative periods presented in accordance with the previous guidance in ASC 840. The Company is currently evaluating the impact that the adoption of ASU 2016-02 will have on its consolidated financial statements. This evaluation process includes reviewing all forms of leases and performing a completeness assessment over its lease population to identify any embedded leases with their vendors. The Company anticipates that due to this new accounting standard, it will recognize additional assets and corresponding liabilities related to its operating leases on its consolidated balance sheet.

In January 2017, the FASB issued ASU No. 2017-04, *Intangibles—Goodwill and Other: Simplifying the Test for Goodwill Impairment (Topic 350)* ("ASU 2017-04"), which provides for the elimination of Step 2 from the goodwill impairment test. If impairment charges are recognized, the amount recorded will be the amount by which the carrying amount exceeds the reporting unit's fair value with certain limitations. ASU 2017-04 is effective for fiscal years beginning after December 15, 2019. The Company is currently evaluating the potential impact that the adoption of ASU 2017-04 will have on its consolidated financial statements.

In July 2017, the FASB issued ASU No. 2017-11, *Earnings Per Share (Topic 260), Distinguishing Liabilities from Equity (Topic 480), Derivatives and Hedging (Topic 815) I. Accounting for Certain Financial Instruments with Down Round Features II. Replacement of the Indefinite Deferral for Mandatorily Redeemable Financial Instruments of Certain Nonpublic Entities and Certain Mandatorily Redeemable Noncontrolling Interests with a Scope Exception* (“ASU 2017-11”). Part I applies to entities that issue financial instruments, such as warrants, convertible debt or convertible preferred stock that contain down-round features. Part II replaces the indefinite deferral for certain mandatorily redeemable noncontrolling interests and mandatorily redeemable financial instruments of nonpublic entities contained within ASC Topic 480 with a scope exception and does not impact the accounting for these mandatorily redeemable instruments. ASU 2017-11 is required to be adopted for annual periods beginning after December 15, 2018, including interim periods within those fiscal years. The Company is currently evaluating the impact that the adoption of ASU 2017-11 will have on its consolidated financial statements.

In June 2018, the FASB issued ASU No. 2018-07, *Compensation-Stock Compensation (Topic 718)* (“ASU 2018-07”), which aligns the accounting for share-based payment awards issued to employees and non-employees. Under the new guidance, the existing employee guidance will apply to non-employee share-based transactions. The new guidance is effective on January 1, 2019. The Company is currently evaluating the potential impact that this adoption of ASU 2018-07 will have on its consolidated financial statements.

In August 2018, the SEC issued a final rule amending certain disclosure requirements including expanding the disclosure requirements on the analysis of stockholders’ equity for interim financial statements. Under the amendments, an analysis of changes in each caption of stockholders’ equity presented in the consolidated balance sheet must be provided in a note or separate statement. This final rule will be effective for the quarter ended March 31, 2019. The Company is currently evaluating the potential impact that this adoption of this final rule will have on its consolidated financial statements.

In August 2018 the FASB issued ASU No. 2018-13, *Fair Value Measurement (Topic 820): Disclosure Framework - Changes to the Disclosure Requirements for Fair Value Measurement*. This new standard modifies certain disclosure requirements on fair value measurements. This new standard will be effective on January 1, 2020. Early adoption, of the entire amendments or on the provisions that eliminate or modify the requirements, is permitted. The Company does not expect that the adoption of this new standard will have a material impact on our disclosures.

3. Collaboration Agreement

Sanofi Collaboration and License Agreement

On June 8, 2018, the Company entered into the Sanofi Agreement, a collaboration and license agreement with Sanofi to develop mRNA vaccines and mRNA vaccine platform development for up to five infectious disease pathogens (the “Licensed Fields”). The Sanofi Agreement became effective on July 9, 2018, following notice of early termination of the waiting period under the Hart-Scott-Rodino Antitrust Act of 1976.

Under the Sanofi Agreement, the Company and Sanofi have agreed to collaborate to perform certain research and development activities to advance mRNA vaccines and mRNA vaccine platform development during a three-year research term, which may be extended by mutual agreement. Following the research term, the Company is obligated to manufacture clinical product for Sanofi, which the Company estimates may take up to eight years to complete. The collaboration activities will be subject to a collaboration plan to be updated annually. The Sanofi Agreement provides that Sanofi make an upfront payment to the Company of \$45.0 million, which the Company received in July 2018, as well as certain potential milestone payments and option payments, each as further described below. In addition, the Company is eligible to receive from Sanofi tiered royalty payments on worldwide net sales of mRNA vaccines.

Under the terms of the Sanofi Agreement, the Company has granted to Sanofi exclusive, worldwide licenses under applicable patents, patent applications, know-how and materials, including those arising under the collaboration, to develop, commercialize and manufacture mRNA vaccines to prevent, treat or cure diseases, disorders or conditions in humans caused by any three of the Licensed Fields. In addition, pursuant to the terms of the Sanofi Agreement and subject to certain limitations, Sanofi has options to add up to two additional infectious disease pathogens within the granted licenses to the Licensed Fields by exercising either option or both options during a specified option term and paying the Company a \$5.0 million fee per added pathogen. If, prior to the exercise of the options by Sanofi, the Company receives a bona fide third-party offer to acquire rights to the field to which an option relates, the Company must notify Sanofi of such offer, and if Sanofi does not exercise its option as to the applicable field, such field will no longer be subject to the option.

The Company and Sanofi retain the rights to perform their respective obligations and exercise their respective rights under the Sanofi Agreement, and Sanofi may grant sublicenses to affiliates or third parties. Sanofi has also granted the Company non-exclusive, sublicensable licenses under patent rights claiming certain improvements that Sanofi may make to the technology the Company has

licensed to it or claiming certain technology arising from the collaboration and owned by Sanofi. The Company may exercise such licenses to develop, manufacture and commercialize products, other than products that use a vaccine to prevent, treat or cure a disease, disorder or condition in humans caused by an infectious disease pathogen. If the Company commercializes any product covered by such a Sanofi patent right, the Company would pay Sanofi a royalty of a low single-digit percentage. Sanofi may terminate these licenses to the Company if the Company materially breaches the terms of the license and the breach remains uncured for a specified period, which may be extended in certain circumstances.

Under the Sanofi Agreement, the Company and Sanofi created a governance structure, including committees and working groups, to manage the activities under the collaboration. If the Company and Sanofi do not mutually agree on certain decisions, Sanofi would be able to break a deadlock without the Company's consent. The collaboration includes an estimated budget. Sanofi is responsible for paying the Company's employee costs, out-of-pocket costs paid to third parties and manufacturing costs, up to a specified amount.

Sanofi has sole responsibility for all commercialization activities for mRNA vaccines in the Licensed Fields and is obligated to bear all costs in connection with any such commercialization. The Company and Sanofi intend to enter into a supply agreement pursuant to which the Company would be responsible for manufacturing certain non-clinical and clinical mRNA vaccines and materials containing mRNA until the Company transfers such manufacturing capabilities to Sanofi. The Company would be entitled to receive payments for manufacturing mRNA vaccines under the supply agreement.

The Sanofi Agreement provides that the Company is eligible to receive aggregate potential payments of up to \$805.0 million from Sanofi, which includes an upfront payment, potential milestone payments and potential option exercise payments. In July 2018, Sanofi paid the Company a \$45.0 million upfront payment in respect of the licenses and options granted to Sanofi. Sanofi will also pay the Company \$5.0 million with respect to each additional Licensed Field for which it exercises an option. Sanofi has also agreed to pay the Company milestone payments upon the achievement of specified development, regulatory and commercialization milestones. In particular, the Company is entitled to receive development and regulatory milestone payments of up to \$63.0 million per Licensed Field and sales milestone payments of up to \$85.0 million per Licensed Field. In addition, the Company is entitled to receive a \$10.0 million milestone payment from Sanofi following completion of the technology and process transfer.

Sanofi has agreed to pay the Company a tiered royalty on worldwide net sales of all mRNA vaccines within each Licensed Field ranging from a high single-digit percentage to a low teens percentage, depending on quarterly net sales by Sanofi, its affiliates and its sublicensees. The royalty paid to the Company can be reduced with respect to a product once the relevant licensed patent rights expire or if additional licensed technology is required, but the royalty payments generally may not fall below the Company's royalty obligations to third-parties plus a royalty of a low single-digit percentage. Royalty payments under the Sanofi Agreement are payable on a product-by-product and country-by-country basis beginning on the launch of the product in the country until the later of the expiration of the last valid claim covering such product or 10 years after the launch of such product in such country.

The Sanofi Agreement provides that it will remain in effect until terminated in accordance with its terms. Either the Company or Sanofi may terminate the Sanofi Agreement in its entirety if the other party is subject to certain insolvency proceedings. Either party may terminate the Sanofi Agreement in its entirety or with respect to a particular Licensed Field, country or product if the other party materially breaches the Sanofi Agreement and the breach remains uncured for a specified period, which may be extended in certain circumstances. Sanofi may also terminate the Sanofi Agreement in its entirety or with respect to a particular Licensed Field, country or product for safety reasons or for convenience, in each case after a specified notice period. After termination of the Sanofi Agreement, Sanofi may continue to manufacture and commercialize the terminated products for a specified period of time, subject to Sanofi's payment obligations.

Accounting Under ASC 606

In determining the appropriate amount of revenue to be recognized under FASB ASC 606, *Revenue from Contracts with Customers*, ("ASC 606"), the Company performed the following steps: (i) identified the promised goods or services in the contract; (ii) determined whether the promised goods or services are performance obligations including whether they are distinct in the context of the contract; (iii) measurement of the transaction price, including the constraint on variable consideration; (iv) allocation of the transaction price to the performance obligations; and (v) recognition of revenue when (or as) the Company satisfies each performance obligation.

The Company identified the following promised goods or services contained in the Sanofi Agreement: (i) the license it conveyed to Sanofi with respect to the Licensed Fields, (ii) the licensed know-how to be conveyed to Sanofi with respect to the Licensed Fields, (iii) its obligations to perform research and development on the Licensed Fields, (iv) its obligation to transfer licensed materials to Sanofi, (v) its obligation to manufacture and supply certain non-clinical and clinical mRNA vaccines and materials containing mRNA until the Company transfers such manufacturing capabilities to Sanofi and (vi) the technology process

and transfer. The Company assessed whether each of these promised goods or services are distinct performance obligations on their own or if they need to be combined with other promises to create a bundle that is a distinct performance obligation. The Company determined that the promised goods and services do not have standalone value and are highly interrelated. Accordingly, the promised goods and services represent one performance obligation. Sanofi's right to exercise options for up to two additional infectious disease pathogens within the granted licenses to the Licensed Fields are accounted for separately as they do not represent material rights, based on the criteria of ASC 606. Upon the exercise of any option by Sanofi, the contract promises associated with an option target would use a separate proportional performance model for purposes of revenue recognition under ASC 606.

The Company determined the transaction price of the Sanofi Agreement to be \$74.0 million based upon the probability that the consideration associated with each milestone or reimbursement will not be subject to a significant reversal in the cumulative amount of revenue recognized. The transaction price includes the upfront, non-refundable payment of \$45.0 million for the transfer of the combined license, supply and development obligations under the Sanofi Agreement, an estimated \$8.8 million in reimbursable employee costs and an estimated \$20.2 million in reimbursable development costs including out-of-pocket costs paid to third parties and manufacturing costs. Reimbursable development costs are payable by Sanofi within 60 days of invoicing. There was no significant financing component or noncash consideration included in the Sanofi Agreement.

Under ASC 606, the Company recognized revenue using the input method, which it believes best depicts the transfer of control to the customer. Under the input method, the extent of progress towards completion is measured based on the ratio of actual costs incurred to the total estimated costs expected upon satisfying the identified performance obligation. Under this method, revenue will be recorded as a percentage of the estimated transaction price based on the extent of progress towards completion. The Company does not include variable consideration to the extent that it is probable that a significant reversal in the amount of cumulative revenue recognized will occur when any uncertainty associated with the variable consideration is resolved. The estimate of the Company's measure of progress and estimate of variable consideration to be included in the transaction price will be updated at each reporting date as a change in estimate. The amount related to the unsatisfied portion will be recognized as that portion is satisfied over time.

The following table summarizes the Company's net revenues from collaboration, for the periods indicated (in thousands):

	Three Months Ended September 30,		Nine Months Ended September 30,	
	2018	2017	2018	2017
Collaboration revenue	\$ 238	\$ —	\$ 238	\$ —

The following table presents the balance of the Company's contract liabilities at September 30, 2018 and December 31, 2017 (in thousands):

	September 30, 2018	December 31, 2017
Contract liabilities		
Deferred revenues	\$ 45,066	\$ —

The Company considers the total consideration expected to be earned in the next twelve months for services to be performed as short-term deferred revenue, and consideration that is expected to be earned subsequent to twelve months from the balance sheet date as long-term deferred revenue. The Company expects to complete its obligations and recognize all net revenues from the collaboration over eight years.

4. Acquisitions, Goodwill and Other Intangible Assets

Acquisition of Shire's MRT Program

On December 22, 2016, the Company entered into an asset purchase agreement (as amended on June 7, 2018, the "Shire Agreement") with Shire pursuant to which Shire sold equipment to and assigned to the Company all of its rights to certain patent rights, permits, real property leases, contracts, regulatory documentation, books and records, and materials related to Shire's MRT Program, including its CFTR and OTC deficiency mRNA therapeutic programs. The Company assumed no liabilities of Shire as part of the Shire Agreement. As part of the acquisition, the scientific founders of the MRT platform and other key members of the Shire program joined the Company to advance the Company's MRT platform and the development of its product candidates. Under the Shire Agreement, the Company is obligated to use commercially reasonable efforts to develop and seek and obtain regulatory approval for products that include or are composed of MRT compounds covered by or derived from patent rights or know-how acquired from Shire ("MRT Products") and to achieve specific developmental milestones. During the earnout period described below, with respect to any MRT Product in any country, the Company is obligated to use commercially reasonable efforts to market and sell such MRT Product in such country.

The Company accounted for the acquisition of the assets and employees as a business combination. As consideration for the acquisition, the Company issued 5,815,560 shares of common stock to Shire and agreed to make potential future milestone and

earnout payments to Shire upon the occurrence of specified commercial milestones. In particular, the Company is obligated to make milestone payments to Shire of up to \$60.0 million in the aggregate upon the occurrence of specified commercial milestones, including upon the first commercial sale of an MRT Product for the treatment of CF and upon the achievement of a specified level of annual net sales with respect to an MRT Product. The Company is also obligated to make additional milestone payments of \$10.0 million for each non-CF MRT Product upon the first commercial sale of a non-CF MRT Product; provided that such milestone payments will only be due once for any two non-CF MRT Products that contain the same MRT compounds or once per non-CF MRT Product that is a vaccine developed under the Company's collaboration with Sanofi (see Note 3).

Under the Shire Agreement, the Company is also obligated to pay a quarterly earnout payment of a mid-single-digit percentage of net sales of each MRT Product. The earnout period, which is determined on a product-by-product and country-by-country basis, will begin on the date of the first commercial sale of such MRT Product in such country and will end on the later of (i) ten years after such first commercial sale and (ii) the expiration of the last valid claim of the patent rights acquired from Shire or derived from patent rights or know-how acquired from Shire covering such MRT Product in such country.

Under the Shire Agreement, the Company was obligated to consummate an equity financing of at least \$100.0 million (the "Subsequent Financing"). As part of the Shire Agreement, the Company provided Shire anti-dilution rights whereby it agreed to issue Shire additional common stock such that Shire will own, upon the completion of the Subsequent Financing, either (i) 18.0% of the Company's common stock on an as-converted and fully diluted basis or (ii) if less, 19.9% of the voting power of all then outstanding common stock of the Company, excluding shares of unvested restricted stock. Under the Shire Agreement, until the Subsequent Financing was consummated, the Company was obligated to use the first \$50.0 million of gross proceeds from the Subsequent Financing solely for activities and expenses associated with the MRT Program. As a result of the Company's IPO, the Company fully satisfied the Subsequent Financing obligation. In addition, as a result of and concurrent with the closing of the Company's IPO on July 2, 2018, the Company issued 183,619 shares of common stock to Shire in full satisfaction of the Company's anti-dilution obligations to Shire (see Note 5).

Elements of Purchase Consideration

As part of its accounting for the business combination, the Company recorded the fair value of the common stock issued on the acquisition date as well as contingent consideration liabilities for the potential future milestone and earnout payments and for the anti-dilution rights provided to Shire through the completion of the Subsequent Financing. The aggregate acquisition-date fair value of consideration transferred was determined to be \$112.2 million, consisting of the following (in thousands):

Fair value of common stock	\$ 41,089
Fair value of contingent consideration — potential milestone and earnout payments	62,666
Fair value of contingent consideration — anti-dilution rights	8,407
Total fair value of purchase consideration	<u>\$ 112,162</u>

Common Stock Issued at Closing. The fair value of the 5,815,560 shares of common stock issued on the acquisition date, aggregating \$41.1 million, was determined based on the fair value of \$7.06 per share of common stock estimated by the Company at the acquisition date based, in part, on the results of a third-party valuation. The third-party valuation was prepared using a hybrid method, which used market approaches to estimate the Company's equity value, including an OPM backsolve based on the \$1.98 price per share of Series C redeemable convertible preferred stock sold by the Company in a Series C financing on the same date as the acquisition date of the MRT Program (see Note 8). The hybrid method is a probability-weighted expected return method ("PWERM") where the equity value in one or more of the scenarios is allocated using an option-pricing method ("OPM"). In the third-party valuation, two types of future-event scenarios were considered: an IPO scenario and a remain-private scenario. Each type of future-event scenario was probability weighted by the Company based on an evaluation of its historical and forecasted performance and operating results, an analysis of market conditions at the time, and its expectations as to the timing and likely prospects of the future-event scenarios. A discount for lack of marketability was then applied to arrive at an indication of fair value per share of the common stock.

Liabilities for Contingent Consideration. The fair value of the contingent consideration related to potential future milestone and earnout payments that may be due to Shire was estimated by the Company at the acquisition date based, in part, on the results of a third-party valuation. The third-party valuation was prepared using a discounted cash flow analysis based on various assumptions, including the probability of achieving specified events, discount rates, and the period of time until earnout payments are payable and the conditions triggering the milestone payments are met.

The fair value of the contingent consideration related to Shire's anti-dilution rights was estimated by the Company at the acquisition date based, in part, on the results of a third-party valuation. The third-party valuation was prepared using a PWERM, which considered as inputs the probability of occurrence of events that would trigger the issuance of additional shares, the expected timing of such events, the expected value of the contingently issuable equity upon the occurrence of a triggering event and a risk-adjusted discount rate.

The Company assessed the anti-dilution rights provided to Shire and determined that the rights (i) met the definition of a freestanding financial instrument that was not indexed to the Company's own stock and (ii) did not meet the definition of a derivative. As the rights did not meet the definition of a derivative and did not qualify for equity classification, the Company determined to classify the anti-dilution rights as a liability. Accordingly, the Company recognized the liability at fair value on the acquisition date and recognizes changes in the fair value of the anti-dilution rights at each subsequent reporting period in the consolidated statements of operations (see Note 5).

Allocation of the Purchase Consideration

The acquisition of Shire's MRT Program was accounted for in accordance with the acquisition method of accounting for business combinations. Acquisition-related costs totaling \$3.0 million were expensed to general and administrative expenses as incurred. Such acquisition-related costs included \$0.5 million for the services of the investment bank that facilitated the acquisition payable in shares of the Company's common stock, which was satisfied in December 2017 through the Company's issuance of 70,866 shares of common stock. The total consideration transferred was allocated to the tangible and identifiable intangible assets acquired based on their estimated fair values as follows (in thousands):

Identifiable intangible assets	\$ 106,907
Property and equipment	2,416
Deferred tax assets	1,308
Deferred tax liabilities	(18,520)
Valuation allowance for deferred tax assets	(1,308)
Goodwill	21,359
Total purchase price consideration	<u>\$ 112,162</u>

Identifiable intangible assets acquired in the acquisition consisted of IPR&D and a lease-based asset. The IPR&D included ongoing projects that could further the Company's preclinical and clinical development activities related to CF, OTC and other potential rare diseases. The lease-based intangible asset related to the below-market rental expense that the Company was expected to benefit from over the remaining lease period at one of its leased facilities. The IPR&D was determined to be indefinite-lived, and the lease-based intangible asset was determined to be definite-lived, with an estimated useful life of 1.5 years. The fair values of the identifiable intangible assets as of the acquisition date were as follows (in thousands):

In-process research and development — MRT	\$ 45,992
In-process research and development — CF	42,291
In-process research and development — OTC	18,559
Lease agreement	65
Total identifiable intangible assets	<u>\$ 106,907</u>

The fair value of the IPR&D assets acquired was estimated by the Company at the acquisition date based, in part, on the results of the third-party valuation. The third-party valuation was prepared using the multi-period excess earnings method ("MPEEM"), a form of the income approach, which assumes the fair value of an intangible asset is equal to the present value of the incremental risk-adjusted after-tax cash flows attributable only to each IPR&D the intangible asset. The MPEEM determined the after-tax cash flows, adjusted for contributory charges and cumulative probabilities of technical success. The probability-adjusted cash flows were then discounted to present value by the selected discount rate and added to the tax amortization benefit to determine the fair value. The key assumptions used in this model were net revenue projections, phase of development assumptions and discount rates. Upon commencement of the Sanofi Agreement, the MRT program was reclassified from IPR&D to definite-lived intangible assets and the Company began amortization of the MRT intangible asset. Amortization will be recorded over an estimated eight-year period based on an economic consumption model.

A deferred tax liability of \$18.5 million was recorded as part of the business combination for the non-deductible portion of the indefinite-lived IPR&D acquired. As part of the business combination, the Company also recorded \$1.3 million of acquired deferred tax assets related to depreciation of property and equipment, but recorded those with a full valuation allowance due to the uncertainty of realizing a benefit from those assets.

The excess of the fair value of the consideration transferred over the fair value of identifiable assets acquired in the acquisition was allocated to goodwill in the amount of \$21.4 million. Goodwill resulting from the acquisition was allocated to the Company's single reporting unit and was largely attributed to the synergies and economies of scale expected from combining the research and operations of the MRT Program and the Company. Substantially all of the goodwill recorded as part of the MRT Program acquisition is not deductible for U.S. federal income tax purposes.

The results of operations of the MRT Program business have been included in the Company's consolidated statements of operations from the acquisition date. The operations of the MRT Program business were fully integrated into the Company's operations and no separate financial results of the business were maintained.

On June 7, 2018, the Company and Shire entered into an amendment to the Shire Agreement to align certain terms of the Shire Agreement with the collaboration and license agreement that the Company entered into with Sanofi on June 8, 2018. Pursuant to this amendment, an mRNA vaccine that is developed pursuant to the Company's collaboration with Sanofi will be considered an MRT Product if it includes an MRT compound having an mRNA sequence that encodes a protein that is from, or that binds to, an infectious disease pathogen in a field that has been licensed by the Company to Sanofi. Pursuant to the amended Shire Agreement, the Company is obligated to make milestone payments of \$10.0 million for each non-CF MRT Product upon the first commercial sale of a non-CF MRT Product; provided that such milestone payments will only be due once for any two non-CF MRT Products that contain the same MRT compounds or once per non-CF MRT Product that is a vaccine developed under the Company's collaboration with Sanofi. The Company has concluded that this amendment will not affect the contingent purchase consideration recorded for accounting purposes.

5. Fair Value of Financial Assets and Liabilities

The following tables present information about the Company's financial assets and liabilities measured at fair value on a recurring basis (in thousands):

	Fair Value Measurements as of September 30, 2018 Using:			
	Level 1	Level 2	Level 3	Total
Assets:				
Money market funds	\$ —	\$ 24,179	\$ —	\$ 24,179
U.S. government agency bonds	—	122,236	—	122,236
	<u>\$ —</u>	<u>\$ 146,415</u>	<u>\$ —</u>	<u>\$ 146,415</u>
Liabilities:				
Contingent consideration	\$ —	\$ —	\$ 118,211	\$ 118,211
	<u>\$ —</u>	<u>\$ —</u>	<u>\$ 118,211</u>	<u>\$ 118,211</u>
	Fair Value Measurements as of December 31, 2017 Using:			
	Level 1	Level 2	Level 3	Total
Assets:				
Money market funds	\$ —	\$ 28,636	\$ —	\$ 28,636
U.S. government agency bonds	—	9,997	—	9,997
	<u>\$ —</u>	<u>\$ 38,633</u>	<u>\$ —</u>	<u>\$ 38,633</u>
Liabilities:				
Contingent consideration	\$ —	\$ —	\$ 81,009	\$ 81,009
	<u>\$ —</u>	<u>\$ —</u>	<u>\$ 81,009</u>	<u>\$ 81,009</u>

During the nine months ended September 30, 2018 and the year ended December 31, 2017, there were no transfers between Level 1, Level 2 and Level 3.

Cash equivalents as of September 30, 2018 and December 31, 2017 consisted of money market funds totaling \$24.2 million and \$28.6 million, respectively. The money market funds were valued using inputs observable in active markets for similar securities, which represent a Level 2 measurement in the fair value hierarchy. The Company's short-term investments as of September 30, 2018 and December 31, 2017 consisted of U.S. government agency bonds and were classified as available-for-sale securities. The U.S. government agency bonds were valued using inputs observable in active markets for similar securities, which represent a Level 2 measurement in the fair value hierarchy. As of September 30, 2018, the Company's short-term investments had an amortized cost of \$122.3 million, an unrealized loss of \$0.1 million and a fair value of \$122.2 million. All of these securities have a maturity of one year or less.

Valuation of Contingent Consideration

The contingent consideration liability related to the acquisition of the MRT Program was classified as Level 3 measurement within the fair value hierarchy and includes the potential future milestone and earnout payments that may be due by the Company to

Shire (see Note 4) and prior to the IPO, an anti-dilution liability with respect to shares issuable by the Company to Shire upon a qualified financing event (see Note 4).

The fair value of the liability to make potential future milestone and earnout payments was estimated by the Company at each reporting date based, in part, on the results of a third-party valuation using a discounted cash flow analysis based on various assumptions, including the probability of achieving specified events, discount rates, and the period of time until earnout payments are payable and the conditions triggering the milestone payments are met. The actual settlement of contingent consideration could differ from current estimates based on the actual occurrence of these specified events.

The fair value of the anti-dilution liability was estimated by the Company at each reporting date based, in part, on the results of a third-party valuation using the PWERM, which considers as inputs the probability of occurrence of events that would trigger the issuance of shares, the expected timing of such events, the expected value of the contingently issuable equity upon the occurrence of a triggering event and a risk-adjusted discount rate.

The following tables presents the unobservable inputs and fair value of the components of the contingent consideration (dollar amounts in thousands):

	Unobservable Inputs at September 30, 2018 and December 31, 2017		Fair Value at	
	Discount Rate	Projected Year of Payment	September 30,	December 31,
			2018	2017
Earnout payments	13.0% - 15.0%	2025 - 2039	\$ 109,005	\$ 72,896
Milestone payments	13.0% - 15.0%	2025 - 2030	9,206	6,817
Anti-dilution rights	1.39% - 1.64%	N/A	—	1,296
			<u>\$ 118,211</u>	<u>\$ 81,009</u>

The following table presents a roll-forward of the total acquisition-related contingent consideration liability (in thousands):

	Fair Value
Balance as of December 31, 2017	\$ 81,009
Change in fair value of contingent consideration	39,589
Issuance of common stock in full settlement of contingent consideration anti-dilution liability	(2,387)
Balance as of September 30, 2018	<u>\$ 118,211</u>

The increase in the fair value of contingent consideration during the nine months ended September 30, 2018 was primarily due to the continued progress of MRT5005, including the initiation in May 2018 of the Company's Phase 1/2 clinical trial of MRT5005 for the treatment of patients with CF, the continued advancement of MRT5201 for which we plan to initiate a Phase 1/2 clinical trial in the first half of 2019, the time value of money due to the passage of time, as well as a decrease in the discount rate.

In December 2017, as a result of the Company's issuance and sale of 21,202,710 shares of Series C redeemable convertible preferred stock at that same time (see Note 8), the Company issued to Shire 1,079,765 shares of common stock, with an aggregate fair value of \$8.0 million, pursuant to the anti-dilution rights conveyed to Shire in the Shire Agreement (see Note 4). The shares issued to Shire were in partial settlement of the Company's anti-dilution contingent consideration liability that was recorded in its purchase accounting for the MRT Program in December 2016 and reflected as current portion of contingent consideration on the Company's consolidated balance sheet as of December 31, 2017. The Company's obligation related to these anti-dilution rights remained in effect until the Company consummated an additional equity financing of \$7.0 million. Pursuant to the anti-dilution rights conveyed to Shire, and after giving effect to the closing of the Company's IPO, which satisfied the Subsequent Financing requirement, the total shares of common stock that Shire was entitled to own was determined to be 7,078,945 shares. Prior to the Company's IPO, the Company had issued 6,895,326 shares of common stock to Shire in accordance with these anti-dilution rights. Accordingly, on July 2, 2018, concurrent with the closing of the Company's IPO, the Company issued an additional 183,619 shares of common stock to Shire in full satisfaction of the Company's anti-dilution rights obligations to Shire. As of September 30, 2018, the Company has fully satisfied its anti-dilution obligations to Shire.

As of September 30, 2018 and December 31, 2017, the fair value of the anti-dilution contingent consideration liability was \$0 and \$1.3 million, respectively.

6. Property and Equipment, Net

Property and equipment, net consisted of the following (in thousands):

	September 30, 2018	December 31, 2017
Laboratory equipment	\$ 5,951	\$ 5,382
Computer equipment	668	481
Office equipment	819	249
Leasehold improvements	5,634	1,131
Construction in progress	1,403	2,591
	14,475	9,834
Less: Accumulated depreciation and amortization	(4,407)	(3,056)
	<u>\$ 10,068</u>	<u>\$ 6,778</u>

Depreciation and amortization expense related to property and equipment was \$0.5 million, \$0.4 million, \$1.9 million and \$1.1 million for the three months ended September 30, 2018 and 2017 and the nine months ended September 30, 2018 and 2017, respectively. Construction in progress recorded as of December 31, 2017 primarily related to in-process construction of leasehold improvements, which were transferred to leasehold improvements in April 2018 upon completion.

7. Accrued Expenses

Accrued expenses consisted of the following (in thousands):

	September 30, 2018	December 31, 2017
Accrued employee compensation and benefits	\$ 2,951	\$ 2,252
Accrued external research and development expenses	1,835	1,115
Accrued consultant and professional fees	818	1,130
Other	202	1,391
	<u>\$ 5,806</u>	<u>\$ 5,888</u>

8. Redeemable Convertible Preferred Stock

As of September 30, 2018 and December 31, 2017, the Company's certificate of incorporation, as amended and restated, authorized the Company to issue no shares and 145,833,064 shares, respectively, of redeemable convertible preferred stock. As of December 31, 2017, the Company had 36,194,026 shares of Series A redeemable convertible preferred stock (the "Series A preferred stock"), 59,133,987 shares of Series B redeemable convertible preferred stock (the "Series B preferred stock") and 46,960,279 shares of Series C redeemable convertible preferred stock (the "Series C preferred stock") issued and outstanding. The Series A preferred stock, Series B preferred stock and Series C preferred stock were redeemable and convertible by the holders under specified conditions. The redeemable convertible preferred stock is classified outside of stockholders' equity (deficit) because the shares contain redemption features that are not solely within the control of the Company. The Series A preferred stock, Series B preferred stock and Series C preferred stock are collectively referred to as the "Preferred Stock."

In December 2017, the Company issued and sold 21,202,710 shares of Series C preferred stock at a price of \$1.98 per share for aggregate proceeds of \$41.9 million, net of issuance costs of \$0.1 million.

Upon issuance of each class of Preferred Stock, the Company assessed the embedded conversion and liquidation features of the securities and determined that such features did not require the Company to separately account for these features. The Company also concluded that no beneficial conversion feature existed upon the issuance date of each class of Preferred Stock or as of December 31, 2017.

Upon the closing of the Company's IPO on July 2, 2018, all then-outstanding shares of Preferred Stock converted into an aggregate of 25,612,109 shares of common stock according to their terms. As of September 30, 2018 there were no shares of Preferred Stock authorized, issued or outstanding.

As of December 31, 2017, Preferred Stock consisted of the following (in thousands, except share amounts):

	December 31, 2017				
	Preferred Shares Authorized	Preferred Shares Issued and Outstanding	Carrying Value	Liquidation Preference	Common Stock Issuable Upon Conversion
Series A preferred stock	36,194,026	36,194,026	\$ 36,194	\$ 36,194	6,514,986
Series B preferred stock	59,133,987	59,133,987	64,002	63,199	10,644,210
Series C preferred stock	50,505,051	46,960,279	92,700	92,981	8,452,913
	<u>145,833,064</u>	<u>142,288,292</u>	<u>\$ 192,896</u>	<u>\$ 192,374</u>	<u>25,612,109</u>

9. Preferred Stock

On July 2, 2018, in connection with the closing of the Company's IPO, the Company filed its restated certificate of incorporation, which authorizes the Company to issue up to 10,000,000 shares of preferred stock, \$0.001 par value per share. There are no shares of preferred stock outstanding as of September 30, 2018.

10. Common Stock

As of December 31, 2017, the Company's certificate of incorporation, as amended and restated, authorized the Company to issue 236,092,611 shares of common stock, \$0.001 par value per share. On July 2, 2018, the Company filed its restated certificate of incorporation, which authorizes the Company to issue up to 200,000,000 shares of common stock.

Each share of common stock entitles the holder to one vote for each share of common stock held. Common stockholders are entitled to receive dividends, as declared by the board of directors. These dividends are subject to the preferential dividend rights of the holders of the Company's preferred stock. Through September 30, 2018 and December 31, 2017, no cash dividends have been declared or paid.

As of December 31, 2017, the Company had reserved 32,115,490 shares of common stock for the conversion of outstanding shares of Preferred Stock (see Note 9), the exercise of outstanding stock options (see Note 11) and the number of shares remaining available for future issuance under the 2018 Equity Incentive Plan (see Note 11). Upon the completion of the Company's IPO on July 2, 2018, all shares of Preferred Stock converted to common stock.

11. Incentive Stock Options and Restricted Stock

2018 Equity Incentive Plan

On March 7, 2018, the Company's board of directors, subject to stockholder approval, adopted, and on June 15, 2018, its stockholders approved, the 2018 Equity Incentive Plan (the "2018 Plan"), which became effective on June 27, 2018. The 2018 Plan provides for the grant of incentive stock options, non-qualified stock options, stock appreciation rights, restricted stock awards, restricted stock units and other stock-based awards.

The number of shares initially reserved for issuance under the 2018 Plan is the sum of 2,512,187, plus the number of shares (up to 1,013,167 shares) equal to the sum of (i) the number of shares remaining available for issuance under the 2016 Stock Incentive Plan, as amended, (the "2016 Plan"), upon the effectiveness of the 2018 Plan, which was 360,514 shares, and (ii) the number of shares of common stock subject to outstanding awards under the 2016 Plan that expire, terminate or are otherwise surrendered, canceled, forfeited or repurchased by the Company at their original issuance price pursuant to a contractual repurchase right. The number of shares of common stock that may be issued under the 2018 Plan will automatically increase on the first day of each fiscal year, beginning with the fiscal year ending December 31, 2019 and continuing for each fiscal year until, and including, the fiscal year ending December 31, 2028, equal to the lowest of (i) 3,349,582 shares, (ii) 4% of the outstanding shares of common stock on such date and (iii) an amount determined by the Company's board of directors. The shares of common stock underlying any awards that are forfeited, canceled, held back upon exercise or settlement of an award to satisfy the exercise price or tax withholding, repurchased or are otherwise terminated by the Company under the 2018 Plan will be added back to the shares of common stock available for issuance under the 2018 Plan. During the nine months ended September 30, 2018, option awards to purchase 148,176 shares of common stock were granted under the 2018 Plan.

Shares that are expired, terminated, surrendered or canceled under the 2018 Plan without having been exercised will be available for future grants of awards. In addition, shares of common stock that are tendered to the Company by a participant to exercise an award are added to the number of shares of common stock available for the grant of awards.

The 2018 Plan is administered by the board of directors. The exercise prices, vesting periods and other restrictions are determined at the discretion of the board of directors, except that the exercise price per share of options may not be less than 100% of the fair market value of the common stock on the date of grant. Stock options awarded under the 2018 Plan expire ten years after the grant date, unless the board of directors sets a shorter term. Awards granted to employees, officers, members of the board of directors and consultants typically vest over a four-year period.

Unvested stock options are forfeited upon the recipient ceasing to provide services to the Company. The Company may, upon notice to the recipient within six months after the date the recipient ceases to provide such services, repurchase some or all of the vested stock options, at a price equal to the amount that would be distributed with respect to such options under the terms of the Company's restated certificate of incorporation.

2018 Employee Stock Purchase Plan

On March 7, 2018, the Company's board of directors, subject to stockholder approval, adopted, and on June 15, 2018, its stockholders approved the 2018 Employee Stock Purchase Plan (the "2018 ESPP"), which became effective on June 27, 2018. A total of 418,697 shares of common stock were initially reserved for issuance under this plan. The number of shares of common stock that may be issued under the 2018 ESPP will automatically increase on the first day of each fiscal year, beginning with the fiscal year commencing on January 1, 2019 and continuing for each fiscal year until, and including, the fiscal year commencing on January 1, 2029, equal to the lowest of (i) 837,395 shares, (ii) 1% of the outstanding shares of common stock on such date and (iii) an amount determined by the Company's board of directors.

As of September 30, 2018, no shares had been issued under the 2018 ESPP.

2016 Stock Incentive Plan

The 2016 Plan provided for the Company to issue equity awards to employees, officers and directors, consultants and advisors. Under the 2016 Plan, the Company was allowed to grant stock options, stock appreciation rights, restricted stock and restricted stock units. Shares that are expired, terminated, surrendered or canceled under the 2016 Plan without having been exercised will be available for future grants of awards under the 2018 Plan. In addition, shares of common stock that are tendered to the Company by a participant to exercise an award are added to the number of shares of common stock available for the grant of awards under the 2018 Plan.

The 2016 Plan was administered by the board of directors. The exercise prices, vesting periods and other restrictions were determined at the discretion of the board of directors, except that the exercise price per share of options may not be less than 100% of the fair market value of the common stock on the date of grant. Stock options awarded under the 2016 Plan expire ten years after the grant date, unless the board of directors set a shorter term. Stock options and restricted stock granted to employees, officers, members of the board of directors and consultants typically vest over a four-year period.

Upon the effectiveness of the 2018 Plan on June 27, 2018, no further awards will be made under the 2016 Plan. Awards outstanding under the 2016 Plan will continue to be governed by their existing terms. During the nine months ended September 30, 2018, option awards to purchase 1,966,114 shares of common stock were granted under the 2016 Plan.

Stock Options

The following table summarizes the Company's stock option activity since December 31, 2016 (in thousands, except share and per share amounts):

	Number of Shares	Weighted Average Exercise Price	Weighted Average Remaining Contractual Term (in years)	Intrinsic Value
Outstanding as of December 31, 2016	209,797	\$ 4.73	9.70	\$ —
Granted	4,257,593	\$ 7.28		
Forfeited	(102,474)	\$ 7.06		
Outstanding as of December 31, 2017	4,364,916	\$ 7.17	9.79	\$ 977
Granted	2,114,290	\$ 8.84		
Exercised	(49,459)	\$ 5.62		
Forfeited	(188,163)	\$ 6.16		
Outstanding as of September 30, 2018	6,241,584	\$ 7.78	9.00	\$ 13,883
Vested as of September 30, 2018	1,484,129	\$ 7.11	8.06	\$ 4,283
Vested and expected to vest as of September 30, 2018	6,241,584	\$ 7.78	9.00	\$ 13,883
Vested as of December 31, 2017	661,593	\$ 7.04	9.72	\$ 231
Vested and expected to vest as of December 31, 2017	4,364,916	\$ 7.17	9.79	\$ 977

The aggregate intrinsic value of options is calculated as the difference between the exercise price of the options and the fair value of the Company's common stock for those options that had exercise prices lower than the fair value of the Company's common stock. The aggregate intrinsic value of stock options exercised during the nine months ended September 30, 2018 was \$0.2 million. There were no options exercised during the nine months ended September 30, 2017.

The weighted average grant-date fair value per share of stock options granted was \$5.97 and \$4.18 during the nine months ended September 30, 2018 and 2017, respectively.

The total fair value of options vested during the nine months ended September 30, 2018 was \$3.3 million.

Stock Option Valuation

The fair value of stock option grants is estimated using the Black-Scholes option-pricing model. The Company historically has been a private company and lacks company-specific historical and implied volatility information. Therefore, it estimates its expected stock volatility based on the historical volatility of a publicly traded set of peer companies and expects to continue to do so until such time as it has adequate historical data regarding the volatility of its own traded stock price. For options with service-based vesting conditions, the expected term of the Company's stock options has been determined utilizing the "simplified" method for awards that qualify as "plain-vanilla" options. The expected term of stock options granted to non-employees is equal to the contractual term of the option award. The risk-free interest rate is determined by reference to the U.S. Treasury yield curve in effect at the time of grant of the award for time periods approximately equal to the expected term of the award. Expected dividend yield is based on the fact that the Company has never paid cash dividends and does not expect to pay any cash dividends in the foreseeable future.

The following table presents, on a weighted average basis, the assumptions used in the Black-Scholes option-pricing model to determine the grant-date fair value of stock options granted to employees and directors:

	Nine Months Ended September 30,	
	2018	2017
Risk-free interest rate	2.81%	2.02%
Expected term (in years)	6.0	6.0
Expected volatility	75.6%	63.6%
Expected dividend yield	0%	0%

The following table presents the assumptions used in the Black-Scholes option-pricing model to determine the grant-date fair value of stock options granted to a non-employee:

	Nine Months Ended September 30, 2017
Risk-free interest rate	2.08%
Expected term (in years)	10.0
Expected volatility	60.9%
Expected dividend yield	0%

There were no stock options granted to non-employees during the nine months ended September 30, 2018. During the nine months ended September 30, 2017, the Company granted to non-employees stock options for the purchase of 265,854 shares of common stock.

Restricted Common Stock

The following table summarizes the Company's restricted stock activity since December 31, 2016:

	Number of Shares	Weighted Average Grant-Date Fair Value
Unvested restricted common stock outstanding as of December 31, 2016	986,893	\$ 1.10
Forfeited restricted common stock	(100,563)	\$ 1.10
Vested restricted common stock	<u>(359,852)</u>	\$ 1.04
Unvested restricted common stock outstanding as of December 31, 2017	526,478	\$ 1.14
Forfeited restricted common stock	(311)	\$ 1.28
Vested restricted common stock	<u>(235,900)</u>	\$ 1.03
Unvested restricted common stock outstanding as of September 30, 2018	<u>290,267</u>	\$ 1.23

The total fair value of restricted common stock vested during the nine months ended September 30, 2018 and 2017 was \$0.2 million and \$0.3 million, respectively, which the Company recorded as stock-based compensation during those periods.

Stock-Based Compensation

Stock-based compensation expense was classified in the condensed consolidated statements of operations as follows (in thousands):

	Three Months Ended September 30,		Nine Months Ended September 30,	
	2018	2017	2018	2017
Research and development expenses	\$ 639	\$ 357	\$ 3,092	\$ 993
General and administrative expenses	796	154	2,601	310
	<u>\$ 1,435</u>	<u>\$ 511</u>	<u>\$ 5,693</u>	<u>\$ 1,303</u>

Included in research and development stock-based compensation expense for the nine months ended September 30, 2018 was \$0.3 million related to the modification of options in connection with the resignation of the Company's former Chief Scientific Officer ("CSO"). In connection with this resignation, the Company entered into a separation agreement with the former CSO. Under the terms of the separation agreement, vesting of options for the purchase of 72,871 shares of common stock held by the former CSO was accelerated with no change to the exercise price of such options. Stock options for the purchase of 204,353 shares of common stock, representing all of the options held by the former CSO as of the date of his resignation, are exercisable for one year following his resignation.

As of September 30, 2018, total unrecognized compensation cost related to the unvested stock-based awards was \$21.9 million which is expected to be recognized over weighted average periods of 2.83 years.

12. Income Taxes

2017 U.S. Tax Reform

On December 22, 2017, the Tax Cuts and Jobs Act (the "Tax Act") was signed into United States law. The Tax Act includes a number of changes to existing tax law, including, among other things, a permanent reduction in the federal corporate income tax rate from 34% to 21%, effective as of January 1, 2018, as well as limitation of the deduction for net operating losses to 80% of annual taxable income and elimination of net operating loss carrybacks, in each case, for losses arising in taxable years beginning after December 31, 2017 (though any such net operating losses may be carried forward indefinitely). The enactment of the Tax Act resulted in the Company recording a net income tax benefit of \$6.1 million in the year ended December 31, 2017. The \$6.1 million net income tax benefit consisted of (i) the remeasurement of the deferred tax liabilities for the Company's indefinite-lived intangible assets due to the tax rate reduction, which resulted in a corresponding income tax benefit of \$3.7 million, and (ii) a reduction in the valuation allowance for deferred tax assets related to deductible temporary differences that will generate unlimited net operating loss carryforwards when they reverse in future periods, which resulted in a corresponding income tax benefit of \$2.4 million.

The staff of the Securities and Exchange Commission issued Staff Accounting Bulletin No. 118 to address the application of U.S. GAAP in situations when a registrant does not have the necessary information available, prepared or analyzed (including computations) in reasonable detail to complete the accounting for certain income tax effects of the Tax Act. The Company is still in the process of analyzing the impact to the Company of the Tax Act and its analysis is not yet complete. Where the Company has been able to make reasonable estimates of the effects related to the Tax Act, the Company has recorded provisional amounts. No adjustments to the provisional amounts recorded as of December 31, 2017 were recorded during the three and nine months ended September 30, 2018.

Income Taxes

The Company recognized an income tax benefit of \$2.5 million and \$2.3 million during the three months ended September 30, 2018 and 2017, respectively, and \$5.1 million and \$4.0 million during the nine months ended September 30, 2018 and 2017, respectively. The \$2.5 million and \$5.1 million income tax benefit recognized during the three and nine months ended September 30, 2018, respectively, resulted from a reduction in the deferred tax liabilities recorded as part of the Company's acquisition of the MRT Program as well as deferred tax assets recorded for net operating losses generated in 2018 that have an unlimited carryforward period. Under the Tax Act, net operating losses generated in 2018 and years thereafter can be carried forward indefinitely. As a result, the deferred tax liabilities associated with the Company's indefinite-lived intangible assets may be used as a source of income to support the realization of the federal tax benefit of our indefinite-lived net operating losses generated in 2018. The \$2.3 million and \$4.0 million income tax benefit recognized during the three and nine months ended September 30, 2017, respectively, was due to a reduction of the same amount in the deferred tax liabilities recorded as part of the Company's acquisition of the MRT Program (see Note 4). The reduction in the deferred tax liabilities during the three and nine months ended September 30, 2018 and 2017 resulted from an increase in the tax basis of the indefinite-lived IPR&D recorded in the acquisition.

13. Net Loss per Share

Basic and diluted net loss per share attributable to common stockholders was calculated as follows (in thousands, except share and per share amounts):

	Three Months Ended		Nine Months Ended	
	September 30,		September 30,	
	2018	2017	2018	2017
Numerator:				
Net loss	\$ (42,646)	\$ (18,465)	\$ (91,358)	\$ (50,352)
Accretion of redeemable convertible preferred stock to redemption value	—	(180)	(644)	(539)
Net loss attributable to common stockholders	<u>\$ (42,646)</u>	<u>\$ (18,645)</u>	<u>\$ (92,002)</u>	<u>\$ (50,891)</u>
Denominator:				
Weighted average common shares outstanding—basic and diluted	<u>44,036,206</u>	<u>7,781,398</u>	<u>17,949,026</u>	<u>7,682,179</u>
Net loss per share attributable to common stockholders—basic and diluted	<u>\$ (0.97)</u>	<u>\$ (2.40)</u>	<u>\$ (5.13)</u>	<u>\$ (6.62)</u>

The Company excluded 333,473 shares and 654,951 shares of restricted common stock, presented on a weighted average basis, from the calculations of basic net loss per share attributable to common stockholders for the three months ended September 30, 2018 and 2017, respectively, because those shares had not vested. The Company excluded 411,644 shares and 809,272 shares of restricted common stock, presented on a weighted average basis, from the calculations of basic net loss per share attributable to common stockholders for the nine months ended September 30, 2018 and 2017, respectively, because those shares had not vested.

The Company's potentially dilutive securities, which include stock options, unvested restricted common stock and redeemable convertible preferred stock, have been excluded from the computation of diluted net loss per share attributable to common stockholders as the effect would be to reduce the net loss per share. Therefore, the weighted average number of shares of common stock outstanding used to calculate both basic and diluted net loss per share attributable to common stockholders is the same.

The Company excluded the following potential shares of common stock, presented based on amounts outstanding at each period end, from the computation of diluted net loss per share attributable to common stockholders for the periods indicated because including them would have had an anti-dilutive effect:

	Three and Nine Months Ended	
	September 30,	
	2018	2017
Options to purchase common stock	6,241,584	1,462,468
Unvested restricted common stock	290,267	609,259
Redeemable convertible preferred stock (as converted to common stock)	—	121,085,582
	<u>6,531,851</u>	<u>123,157,309</u>

In addition to the potentially dilutive securities noted above, as of September 30, 2017, the Company was obligated to issue common stock to Shire upon the occurrence of specified events (see Notes 4 and 5). Because the necessary conditions for issuance of the shares had not been met as of September 30, 2017, the Company excluded these shares from the table above and from the calculations of diluted net loss per share for the three and nine months ended September 30, 2017.

14. Commitments and Contingencies

Lease Commitments

The Company leases office, laboratory and other space under operating leases that expired between April 2018 and April 2028. The Company recognizes rent expense on a straight-line basis over the respective lease period and has recorded deferred rent for rent expense incurred but not yet paid. The Company recorded rent expense of \$0.7 million and \$1.1 million during the three months ended September 30, 2018 and 2017, respectively, and \$2.4 million and \$2.2 million during the nine months ended September 30, 2018 and 2017, respectively.

In May 2015, the Company entered into an operating lease for office and laboratory space in Cambridge, Massachusetts, which was due to expire in May 2022. In connection with entering into this lease agreement, the Company issued a letter of credit collateralized by cash deposits totaling \$1.0 million, which was reduced to \$0.7 million in December 2017. These cash deposits are classified as restricted cash on the consolidated balance sheets. In September 2017, the Company and the lessor agreed to early terminate the lease as of April 2018 and the Company was relieved of its obligation to pay the remaining lease payments through the expiration date of the original lease. The Company vacated the leased space in April 2018 and the letter of credit was released during the third quarter of 2018.

Pursuant to the Shire Agreement (see Note 4), in December 2016, the Company assumed an operating lease, due to expire in May 2018, for office and laboratory space in Lexington, Massachusetts. Monthly lease payments of less than \$0.1 million due under the lease included base rent and ancillary charges. In January 2017, in connection with this lease agreement, the Company issued two letters of credit collateralized by cash deposits totaling \$0.3 million, which are classified as restricted cash on the consolidated balance sheets. In November 2017, the lease was amended pursuant to which (i) the lease was extended by 12 months, commencing in June 2018 and expiring in May 2019, and (ii) the landlord was granted the option, at its sole discretion, to terminate the lease upon 90 days' notice, provided that the expiration date will be no earlier than November 30, 2018. On June 22, 2018 the Company entered into a Termination and Surrender Agreement with the landlord relating to this lease subject to certain conditions. In July 2018, following receipt of a \$0.3 million termination payment, the landlord released the Company from any further obligations under the lease. The Company vacated the leased space in June 2018 and the letters of credit were released during the third quarter of 2018.

In June 2017, the Company entered into an operating lease for office and laboratory space at a second location in Lexington, Massachusetts. Monthly lease payments include base rent charges of \$0.2 million, which are subject to a 3% annual increase each year. The lease expires in April 2028. In June 2017, in connection with this lease agreement, the Company issued a letter of credit collateralized by cash deposits of \$1.0 million, which are classified as restricted cash on the consolidated balance sheets as of September 30, 2018 and December 31, 2017.

Research, Supply and License Agreements

Pursuant to the Shire Agreement (see Note 4), in December 2016, the Company was assigned and assumed several contracts related to the MRT Program. The material agreements that were assigned to and assumed by the Company in connection with the acquisition are described below.

Roche Master Supply Agreement

The Company is a party to a master supply agreement with Roche Diagnostics Corporation (“Roche”) pursuant to which Roche will custom manufacture certain products for the Company. The agreement requires the Company to purchase from Roche specified manufactured products and the related raw materials in an amount equal to the greater of (i) quantities of raw materials in the Company’s annual forecast to be purchased or (ii) 80% of the Company’s demand for products as the same or similar type (the “Purchase Commitment”). In June 2017, the Company exercised its option under the agreement to extend the agreement through December 31, 2024. On September 28, 2018, the Company and Roche amended the agreement to remove and replace the Purchase Commitment for certain manufactured products and related raw materials supplied by Roche. The agreement, as amended, specifies a minimum purchase requirement for certain custom manufactured products. As of September 30, 2018, the Company’s purchase commitments under the agreement totaled \$24.0 million, with \$9.6 million committed as payments in 2019, \$0.5 million committed as payments in 2020 and \$3.5 million committed as payments each year from 2021 to 2024. Research and development expenses related to this agreement totaled \$0.8 million and \$0.4 million during the three months ended September 30, 2018 and 2017, respectively, and \$2.5 million and \$0.7 million during the nine months ended September 30, 2018 and 2017, respectively.

MIT Research Agreement

The Company is a party to a research agreement with the Massachusetts Institute of Technology (“MIT”) pursuant to which the Company is obligated to reimburse MIT in an amount up to \$3.1 million for specified direct and indirect costs incurred through October 2019 in specified research activities conducted for the Company. As of September 30, 2018 and December 31, 2017, the Company had paid MIT \$2.2 million and \$1.0 million, respectively, of the total committed amount. As of September 30, 2018, the Company’s research commitments under the agreement totaled \$1.0 million with \$0.3 million committed through 2018 and \$0.7 million committed in 2019. Research and development expenses related to this agreement totaled \$0.3 million and \$0.3 million during the three months ended September 30, 2018 and 2017, respectively, and \$0.9 million and \$0.9 million during the nine months ended September 30, 2018 and 2017, respectively. As of September 30, 2018, amounts payable by the Company under the agreement totaled \$0.

As amended, the agreement expires in October 2019 and may be extended thereafter by mutual agreement of the parties.

MIT Exclusive Patent License Agreement

The Company is a party to an exclusive patent license agreement with MIT pursuant to which the Company received an exclusive license under the licensed patent rights to develop, manufacture and commercialize any product containing both (i) any RNA sequences, including mRNA, that encode a protein or peptide suitable for human therapeutic use which may include operably linked non-coding sequences that facilitate translation of the coding portion of such RNA sequence, but such non-coding sequences do not include nucleic acids that function through an RNA interface mechanism or transcriptional activation mechanism (the “coding RNA component”), and (ii) products covered by the licensed patent rights (the “lipid products”). A product containing both a coding RNA component and a lipid product is referred to as a “licensed product.” Under the licensed patent rights, the Company is permitted to develop, manufacture and commercialize the licensed products for the delivery of coding RNA components to treat disease in humans.

The Company has the right to grant sublicenses under this license. The patent rights licensed to the Company by MIT include claims that cover the Company’s customized lipid-based nanoparticles used for delivery of coding RNA components in its MRT platform and MRT5201.

Under the license agreement, the Company is obligated to make annual license maintenance payments to MIT, payable on January 1 of each calendar year, of up to \$0.2 million, which may be credited against royalties subsequently due on net sales of licensed products earned in the same calendar year. The Company paid no annual license maintenance fees to MIT during the

three months ended September 30, 2018 and 2017 and paid \$0.1 million and \$0.1 million during the nine months ended September 30, 2018 and 2017, respectively.

The Company is also obligated to make milestone payments to MIT aggregating up to \$1.375 million upon the achievement of specified clinical and regulatory milestones with respect to each licensed product and \$1.250 million upon the Company's first commercial sale of each licensed product, and to pay royalties of a low single-digit percentage to MIT based on the Company's, and any of its affiliates and sublicensees, net sales of licensed products. The royalties are payable on a product-by-product and country-by-country basis, and may be reduced in specified circumstances. The Company's obligation to make royalty payments extends with respect to a licensed product in a country until the expiration of the last-to-expire patent or patent application licensed from MIT covering the licensed product in the country. In addition, the Company is obligated to pay MIT a low double-digit percentage of the portion of income from sublicensees that the Company ascribes to the MIT-licensed patents, excluding royalties on net sales and research support payments. Pursuant to such provision, the Company will be required to pay MIT a portion of the \$45.0 million upfront payment received from Sanofi in July 2018 as well as future option and milestone payments that the Company may receive pursuant to the Sanofi Agreement. The amounts that the Company may owe to MIT will depend upon the relative value of the patents the Company licensed from MIT and sublicensed to Sanofi as compared to the other rights that the Company licensed to Sanofi. The determination of the relative value of such rights is subject to a process described in the Company's license agreement with MIT (see Note 3).

The agreement obligates the Company to use commercially reasonable efforts and expend a minimum amount of resources each year to develop licensed products in accordance with a development plan, and a development milestone timetable specified in the agreement; to use commercially reasonable efforts to commercialize licensed products; and upon commercialization, to make the licensed products reasonably available to the public.

MIT has the right to terminate the agreement if the Company fails to pay amounts when due or otherwise materially breaches the agreement and fails to cure such nonpayment or breach within specified cure periods or in the event the Company ceases to carry on its business related to the agreement. In the event of a termination due to the Company's breach caused by a due diligence failure of a licensed product, but where the Company has fulfilled its obligations with respect to a different licensed product, MIT may not terminate the agreement with respect to the different licensed product. MIT may immediately terminate the agreement if the Company or any of its affiliates brings specified patent challenges against MIT or assists others in bringing a patent challenge against MIT. The Company has the right to terminate the agreement for its convenience at any time on three months' prior written notice to MIT and payment of all amounts due to MIT through the date of termination.

The Company's patent rights, and the rights of its affiliates and sublicensees, in specified licensed products may also terminate, if, after November 1, 2018, the Company, its affiliates or MIT receives a request from a third party to develop such licensed product for which the Company is unable to, within nine months of receiving notice of any such request, either demonstrate that the Company has initiated a fully funded project for the commercial development of such licensed product, and provide a business plan with acceptable milestones; demonstrate that the licensed product proposed by such third party would be competitive with a licensed product for which the Company has initiated a fully funded project; or enter into a sublicense agreement with such third party on commercially reasonable terms, and, in each case, MIT, in its sole discretion, grants a license to such third party for the specified patent rights.

Research and development expenses related to this agreement totaled less than \$0.1 million during each of the three months ended September 30, 2018 and 2017, respectively, and \$0.1 million and \$0.1 million during the nine months ended September 30, 2018 and 2017. As of September 30, 2018 and December 31, 2017, no liabilities related to this agreement were recorded by the Company.

Indemnification Agreements

In the ordinary course of business, the Company may provide indemnification of varying scope and terms to vendors, lessors, business partners and other parties with respect to certain matters including, but not limited to, losses arising out of breach of such agreements or from intellectual property infringement claims made by third parties. In addition, the Company has entered into indemnification agreements with members of its board of directors that will require the Company, among other things, to indemnify them against certain liabilities that may arise by reason of their status or service as directors or officers. The maximum potential amount of future payments the Company could be required to make under these indemnification agreements is, in many cases, unlimited. To date, the Company has not incurred any material costs as a result of such indemnifications. The Company does not believe that the outcome of any claims under indemnification arrangements will have a material effect on its financial position, results of operations or cash flows, and it has not accrued any liabilities related to such obligations in its consolidated financial statements as of September 30, 2018 and December 31, 2017.

Legal Proceedings

The Company is not a party to any litigation and does not have contingency reserves established for any litigation liabilities.

15. Related Party Transactions

Consulting Agreement with Daniel S. Lynch

In 2012, the Company entered into a consulting agreement with Daniel S. Lynch, the chairman of the Company's board of directors, for the provision of consulting, advisory and related services. Pursuant to the consulting agreement, as amended through March 2015, Mr. Lynch is entitled to base compensation of \$100,000 per year and is eligible to receive an annual performance bonus of up to 25% of his base compensation. In June 2018, the Company's board of directors approved a director compensation program that became effective on the effective date of the registration statement related to the Company's IPO. The Company has not made any payments to Mr. Lynch under the consulting agreement since the approval of the director compensation program. During the three months ended September 30, 2018 and 2017 and the nine months ended September 30, 2018 and 2017, the Company recorded general and administrative expenses of \$0, \$26,600, \$0.1 million and \$0.1 million, respectively, related to this agreement. During the three months ended September 30, 2018 and 2017 and the nine months ended September 30, 2018 and 2017, the Company paid Mr. Lynch \$0, \$25,000, \$0.1 million and \$0.1 million, respectively, in connection with his services provided under the agreement. As of September 30, 2018 and December 31, 2017, amounts due under this agreement totaled \$0 and \$20,000, respectively, which were included in accrued expenses on the consolidated balance sheets.

As additional compensation for services provided under the consulting agreement, through December 31, 2016, the Company granted to Mr. Lynch 321,823 shares of restricted common stock, which are fully vested. During the year ended December 31, 2017, the Company granted to Mr. Lynch stock options to purchase 85,170 shares of common stock, at an exercise price of \$7.39 per share, which vest monthly over a four-year period. The stock options had a grant-date fair value of \$4.06 per share and an aggregate fair value of \$0.3 million.

Transition Services Agreement with Shire

In connection with entering into the Shire Agreement (see Note 4), the Company and Shire entered into a transition services agreement (the "Transition Agreement") pursuant to which Shire provided certain transition services, such as information technology, finance, legal, facilities-related and regulatory, for nine months following the acquisition of the MRT Program. During the three and nine months ended September 30, 2017, the Company recorded general and administrative expenses of \$0.1 million and \$0.1 million, respectively, and paid Shire \$6,000 and \$20,525, respectively, for the services provided under the Transition Agreement, which expired in September 2017.

16. Costs Associated with Restructuring

In June 2017, the Company implemented a reorganization of its operations, which reduced its workforce by 17 positions in connection with a strategic realignment of resources aimed at better supporting the advancement of its MRT platform. The benefits provided to the employees as part of this reorganization were determined to be involuntary termination benefits provided under the terms of a one-time benefit arrangement pursuant to which employees were not required to provide future services to the Company. During the three and nine months ended September 30, 2017, the Company recorded employee severance charges of \$0 and \$0.5 million, respectively, related to this restructuring, which were included in research and development expenses in the consolidated statements of operations.

Changes in accrued restructuring costs were as follows (in thousands):

Balance at December 31, 2016	\$	—
Charges		473
Payments		(416)
Balance at September 30, 2017		57
Payments		(57)
Balance at December 31, 2017	\$	—

Item 2. Management's Discussion and Analysis of Financial Condition and Results of Operations.

The following discussion and analysis of our financial condition and results of operations should be read in conjunction with our unaudited condensed financial statements and related notes appearing elsewhere in this Quarterly Report on Form 10-Q and our audited financial statements and related notes for the year ended December 31, 2017 included in our final prospectus for our initial public offering of our common stock filed with the Securities and Exchange Commission, or SEC, pursuant to Rule 424(b)(4) on June 29, 2018, which we refer to as the Prospectus.

Some of the statements contained in this discussion and analysis or set forth elsewhere in this Quarterly Report on Form 10-Q, including information with respect to our plans and strategy for our business, constitute forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. We have based these forward-looking statements on our current expectations and projections about future events. The following information and any forward-looking statements should be considered in light of factors discussed elsewhere in this Quarterly Report on Form 10-Q, particularly including those risks identified in Part II-Item 1A "Risk Factors" and our other filings with the SEC.

Our actual results and timing of certain events may differ materially from the results discussed, projected, anticipated, or indicated in any forward-looking statements. We caution you that forward-looking statements are not guarantees of future performance and that our actual results of operations, financial condition and liquidity, and the development of the industry in which we operate may differ materially from the forward-looking statements contained in this Quarterly Report on Form 10-Q. Statements made herein are as of the date of the filing of this Form 10-Q with the SEC and should not be relied upon as of any subsequent date. Even if our results of operations, financial condition and liquidity, and the development of the industry in which we operate are consistent with the forward-looking statements contained in this Quarterly Report on Form 10-Q, they may not be predictive of results or developments in future periods. We disclaim any obligation, except as specifically required by law and the rules of the SEC, to publicly update or revise any such statements to reflect any change in our expectations or in events, conditions or circumstances on which any such statements may be based or that may affect the likelihood that actual results will differ from those set forth in the forward-looking statements.

Overview

We are a clinical-stage messenger RNA, or mRNA, therapeutics company developing a new class of potentially transformative medicines to treat diseases caused by protein or gene dysfunction. Using our proprietary mRNA therapeutic platform, or MRT platform, we create mRNA that encodes functional proteins. We believe that the mRNA design, delivery and manufacturing capabilities of our MRT platform provide us with the most advanced platform for developing product candidates that deliver mRNA encoding functional proteins for therapeutic uses. Our mRNA is delivered to the target cell where the cell's own machinery recognizes it and translates it, restoring or augmenting protein function to treat or prevent disease. We believe that our MRT platform is broadly applicable across multiple diseases in which the production of a desirable protein can have a therapeutic effect. We are initially focused on restoring the expression of intracellular and transmembrane proteins, areas that have eluded conventional protein therapeutics, in patients with genetic diseases where there is high unmet medical need. We are developing our lead MRT product candidate for the lung, MRT5005, for the treatment of cystic fibrosis, or CF, for which we initiated a Phase 1/2 clinical trial in May 2018. We are developing our lead MRT product candidate for the liver, MRT5201, for the treatment of ornithine transcarbamylase, or OTC, deficiency, for which we plan to initiate a Phase 1/2 clinical trial in the first half of 2019. Additionally, we intend to leverage the broad applicability of our platform by identifying lead preclinical candidates for additional lung and liver disease targets, and further through a collaboration with Sanofi Pasteur Inc., or Sanofi, the vaccines global business unit of Sanofi S.A., to develop infectious disease vaccines using mRNA technology for up to five infectious disease pathogens. We believe that our MRT platform is distinct from other mRNA-based technologies and has the potential to provide clinical benefits by transforming life-threatening illnesses into manageable chronic conditions.

Since our inception in 2011, we have devoted substantially all of our focus and financial resources to organizing and staffing our company, business planning, raising capital, acquiring or discovering product candidates and securing related intellectual property rights and conducting discovery, research and development activities for our programs. We do not have any products approved for sale and have not generated any revenue from product sales.

On June 27, 2018, our registration statement on Form S-1 relating to our initial public offering of our common stock, or the IPO, was declared effective by the SEC. In the IPO, which closed on July 2, 2018, we issued and sold 9,350,000 shares of common stock at a public offering price of \$13.00 per share. On July 24, 2018, we issued and sold an additional 364,371 shares of common stock at a price of \$13.00 per share pursuant to the exercise of the underwriters' over-allotment option. The aggregate net proceeds we received from the IPO, inclusive of the proceeds from the over-allotment exercise, were \$113.2 million after deducting underwriting discounts and commissions of \$8.8 million and offering expenses of \$4.3 million. Upon closing of the IPO, all 142,288,292 shares of our redeemable convertible preferred stock then outstanding converted into an aggregate of 25,612,109 shares of common stock.

On June 8, 2018, we entered into a collaboration and license agreement with Sanofi to develop mRNA vaccines for up to five undisclosed infectious disease pathogens, or the Sanofi Agreement. The Sanofi Agreement became effective on July 9, 2018,

following notice of early termination of the waiting period under the Hart-Scott-Rodino Antitrust Act of 1976. Under the Sanofi Agreement, we and Sanofi will jointly conduct research and development activities to advance mRNA vaccines and mRNA vaccine platform development during a three-year research term, which may be extended by mutual agreement.

We are eligible to receive up to \$805.0 million in payments, which includes an upfront payment of \$45.0 million, which we received in July 2018, certain development, regulatory and sales-related milestones across several vaccine targets, and option exercise fees if Sanofi exercises its option related to development of vaccines for additional pathogens. We are also eligible to receive tiered royalty payments associated with worldwide sales of the developed vaccines, if any.

We have funded our operations primarily with proceeds from the sale of redeemable convertible preferred stock and the sale of bridge units, which ultimately converted into shares of our preferred stock, the proceeds from our IPO and an upfront payment received under the Sanofi Agreement. Through September 30, 2018, we had received net cash proceeds of \$113.2 million from our IPO, net cash proceeds of \$189.2 million from sales of our preferred stock and bridge units and \$45.0 million in an upfront payment from Sanofi.

Since our inception, we have incurred significant operating losses. Our ability to achieve profitability will depend heavily on the successful development and eventual commercialization of one or more of our current or future product candidates. Our net losses were \$42.6 million and \$18.5 million for the three months ended September 30, 2018 and 2017, respectively, and \$91.4 million and \$50.4 million for the nine months ended September 30, 2018 and 2017, respectively. As of September 30, 2018, we had an accumulated deficit of \$240.2 million. We expect to continue to incur significant expenses for at least the next several years as we advance our product candidates from discovery through preclinical development and clinical trials and seek regulatory approval of our product candidates. In addition, if we obtain marketing approval for any of our product candidates, we expect to incur significant commercialization expenses related to product manufacturing, marketing, sales and distribution. We may also incur expenses in connection with the in-licensing or acquisition of additional product candidates. We expect to incur additional costs associated with operating as a public company, including significant legal, accounting, investor relations and other expenses that we did not incur as a private company.

As a result, we will need substantial additional funding to support our continuing operations and pursue our growth strategy. Until such time as we can generate significant revenue from product sales, if ever, we expect to finance our operations through the sale of equity, debt financings or other capital sources, including collaborations, strategic partnerships or marketing, distribution or licensing arrangements with third parties or grants from organizations and foundations. We may be unable to raise additional funds or enter into such other agreements or arrangements when needed on favorable terms, or at all. If we fail to raise capital or enter into such agreements as, and when, needed, we may have to significantly delay, scale back or discontinue the development and commercialization of one or more of our product candidates or delay our pursuit of potential in-licenses or acquisitions.

Because of the numerous risks and uncertainties associated with product development, we are unable to predict the timing or amount of increased expenses or when or if we will be able to achieve or maintain profitability. Even if we are able to generate product sales, we may not become profitable. If we fail to become profitable or are unable to sustain profitability on a continuing basis, then we may be unable to continue our operations at planned levels and be forced to reduce or terminate our operations.

As of September 30, 2018, we had cash, cash equivalents and short-term investments of \$161.1 million. We believe that our existing cash, cash equivalents and short-term investments will enable us to fund our operating expenses and capital expenditure requirements into the first half of 2020. We have based this estimate on assumptions that may prove to be wrong, and we could exhaust our available capital resources sooner than we expect. See “—Liquidity and Capital Resources.”

Components of Our Results of Operations

Revenue from Product Sales

To date, we have not generated any revenue from product sales, and we do not expect to generate any revenue from the sale of products in the near future. If our development efforts for our product candidates are successful and result in regulatory approval, we may generate revenue in the future from product sales.

Sanofi Collaboration and License Agreement

In June 2018, we entered into the Sanofi Agreement, a collaboration and license agreement with Sanofi to develop mRNA vaccines and mRNA vaccine platform development for up to three infectious disease pathogens, or the Licensed Fields, plus options to add up to two additional infectious disease pathogens. The Sanofi Agreement became effective in July 2018, following notice of early termination of the waiting period under the Hart-Scott-Rodino Antitrust Act of 1976.

Under the terms of the Sanofi Agreement, we have granted to Sanofi exclusive, worldwide licenses under applicable patents, patent applications, know-how and materials, including those arising under the collaboration, to develop, commercialize and manufacture mRNA vaccines to prevent, treat or cure diseases, disorders or conditions in humans caused by any of the three Licensed Fields.

Under revenue recognition guidance, we account for: (i) the license we conveyed to Sanofi with respect to the Licensed Fields, (ii) the licensed know-how to be conveyed to Sanofi with respect to the Licensed Fields, (iii) our obligations to perform research and development on the Licensed Fields, (iv) our obligation to transfer licensed materials to Sanofi, (v) our obligation to manufacture and supply certain non-clinical and clinical mRNA vaccines and materials containing mRNA until we transfer such manufacturing capabilities to Sanofi and (vi) the technology process and transfer as a single performance obligation. We recognize revenue using the cost-to-cost method, which we believe best depicts the transfer of control to the customer. Under the cost-to-cost method, the extent of progress towards completion is measured based on the ratio of actual costs incurred to the total estimated costs expected upon satisfying the identified performance obligation. Under this method, revenue is recorded as a percentage of the estimated transaction price based on the extent of progress towards completion.

During each of the three and nine months ended September 30, 2018, we recognized revenue of \$0.2 million related to the Sanofi Agreement. There was no revenue recognized under the Sanofi Agreement during the three and nine months ended September 30, 2017.

Operating Expenses

Research and Development Expenses

Research and development expenses consist primarily of costs incurred in connection with the discovery and development of our product candidates. We expense research and development costs as incurred. These expenses include:

- employee-related expenses, including salaries, related benefits and stock-based compensation expense for employees engaged in research and development functions;
- expenses incurred in connection with the preclinical and planned clinical development of our product candidates, including under agreements with third parties, such as consultants and contract research organizations, or CROs;
- the cost of manufacturing drug products for use in our preclinical studies and planned clinical trials, including under agreements with third parties, such as consultants and contract manufacturing organizations, or CMOs;
- laboratory supplies;
- facilities, depreciation and other expenses, which include direct or allocated expenses for rent and maintenance of facilities and insurance;
- costs related to compliance with regulatory requirements; and
- payments made under third-party licensing agreements.

We recognize external development costs based on an evaluation of the progress to completion of specific tasks using information provided to us by our service providers. Nonrefundable advance payments for goods or services to be received in the future for use in research and development activities are recorded as prepaid expenses. Such amounts are recognized as an expense when the services have been performed or the goods have been delivered, or when it is no longer expected that the goods will be delivered or the services rendered. Upfront payments, milestone payments (other than those deemed contingent consideration in a business combination) and annual maintenance fees under license agreements are expensed in the period in which they are incurred.

Our direct research and development expenses are tracked on a program-by-program basis and consist primarily of external costs, such as fees paid to outside consultants, CROs, CMOs and central laboratories in connection with our preclinical development, process development, manufacturing and clinical development activities. Our direct research and development expenses by program also include costs of laboratory supplies incurred for each program as well as fees incurred under license agreements. We do not allocate employee costs or facility expenses, including depreciation or other indirect costs, to specific programs because these costs are deployed across multiple programs and, as such, are not separately classified. We use internal resources primarily to conduct our research and discovery and to manage our preclinical development, process development, manufacturing and clinical development activities.

The table below summarizes our research and development expenses incurred by program:

	Three Months Ended September 30,		Nine Months Ended September 30,	
	2018	2017	2018	2017
	(in thousands)			
CF program (including MRT5005)	\$ 3,884	\$ 3,358	\$ 12,498	\$ 10,774
OTC deficiency program (including MRT5201)	2,636	3,268	7,961	5,645
MRT discovery program	1,432	123	3,439	2,180
Vaccine discovery program	102	—	102	—
Oligonucleotide discovery program	21	186	100	2,246
Unallocated research and development expenses	4,858	4,162	16,754	13,379
Total research and development expenses	\$ 12,933	\$ 11,097	\$ 40,854	\$ 34,224

Research and development activities are central to our business model. Product candidates in later stages of clinical development generally have higher development costs than those in earlier stages, primarily due to the increased size and duration of later-stage clinical trials. As a result, we expect that our research and development expenses will increase substantially over the next several years as we conduct our Phase 1/2 clinical trial of MRT5005 for the treatment of patients with CF; initiate in the first half of 2019 and conduct a Phase 1/2 clinical trial of MRT5201 for the treatment of patients with OTC deficiency; conduct research and development activities to advance mRNA vaccines and develop an mRNA vaccine platform under the Sanofi Agreement; prepare regulatory filings for our product candidates; continue to discover and develop additional product candidates; and potentially advance product candidates from our MRT platform into later stages of clinical development. We expect to continue to devote a substantial portion of our resources to our MRT platform for the foreseeable future.

The successful development and commercialization of our product candidates is highly uncertain. At this time, we cannot reasonably estimate or know the nature, timing and costs of the efforts that will be necessary to complete the preclinical and clinical development of any of our product candidates. This uncertainty is due to the numerous risks and uncertainties associated with product development and commercialization, including the uncertainty of:

- the timing and progress of preclinical and clinical development activities;
- the number and scope of preclinical and clinical programs we decide to pursue;
- our ability to maintain our current research and development programs and to establish new ones;
- establishing an appropriate safety profile with investigational new drug application, or IND, enabling studies;
- successful patient enrollment in, and the initiation and completion of, clinical trials;
- the successful completion of clinical trials with safety, tolerability and efficacy profiles that are satisfactory to the U.S. Food and Drug Administration, or FDA, or any comparable foreign regulatory authority;
- the receipt of regulatory approvals from applicable regulatory authorities;
- the timing, receipt and terms of any marketing approvals from applicable regulatory authorities;
- our ability to establish new licensing or collaboration arrangements;
- the performance of our future collaborators, if any;
- establishing commercial manufacturing capabilities or making arrangements with third-party manufacturers;
- development and timely delivery of commercial-grade drug formulations that can be used in our planned clinical trials and for commercial launch;
- obtaining, maintaining, defending and enforcing patent claims and other intellectual property rights;
- launching commercial sales of our product candidates, if approved, whether alone or in collaboration with others; and
- maintaining a continued acceptable safety profile of the product candidates following approval.

Any changes in the outcome of any of these variables with respect to the development of our product candidates in preclinical and clinical development could mean a significant change in the costs and timing associated with the development of these product candidates. For example, if the FDA or another regulatory authority were to delay our planned start of clinical trials or require us to conduct clinical trials or other testing beyond those that we currently expect, or if we experience significant delays in enrollment in any of our planned clinical trials, we could be required to expend significant additional financial resources and time to complete

clinical development of that product candidate. We may never obtain regulatory approval for any of our product candidates. Drug commercialization will take several years and millions of dollars in development costs.

General and Administrative Expenses

General and administrative expenses consist primarily of salaries, related benefits and stock-based compensation expense for personnel in executive, finance and administrative functions. General and administrative expenses also include facilities, depreciation and other expenses, which include direct or allocated expenses for rent and maintenance of facilities and insurance, as well as professional fees for legal, patent, consulting, investor and public relations, accounting and audit services.

We anticipate that our general and administrative expenses will increase as we increase our headcount to support our continued research activities and development of our product candidates. We also anticipate that we will incur increased accounting, audit, legal, regulatory, compliance, director and officer insurance and investor and public relations costs associated with being a public company.

Change in Fair Value of Contingent Consideration

In connection with our acquisition of the MRT Program, we recognized contingent consideration liabilities for future potential milestone and earnout payment obligations and prior to the IPO, anti-dilution rights with respect to common stock issued to Shire. The contingent consideration was initially recorded at fair value on the acquisition date and is subsequently remeasured to fair value at each reporting date. Any changes in the fair value of the contingent consideration liabilities are recognized as operating income or expenses.

Other Income (Expense), Net

Interest Income

Interest income consists of income recognized in connection with our investments in money market funds and U.S. government agency bonds.

Other Income (Expense), Net

Other income (expense), net consists of miscellaneous income and expense unrelated to our core operations.

Income Taxes

On December 22, 2017, the U.S. government enacted the Tax Cuts and Jobs Act, or the Tax Act. The Tax Act includes a number of changes to existing tax law, including, among other things, a permanent reduction in the federal corporate income tax rate from a top marginal rate of 35% to a flat rate of 21%, effective as of January 1, 2018, as well as limitation of the deduction for net operating losses to 80% of annual taxable income and elimination of net operating loss carrybacks, in each case, for losses arising in taxable years beginning after December 31, 2017 (though any such net operating losses may be carried forward indefinitely).

We recognized an income tax benefit of \$2.5 million and \$2.3 million during the three months ended September 30, 2018 and 2017, respectively, and \$5.1 million and \$4.0 million during the nine months ended September 30, 2018 and 2017, respectively. The \$2.5 million and \$5.1 million income tax benefit recognized during the three and nine months ended September 30, 2018, respectively, resulted from a reduction in the deferred tax liabilities recorded as part of our acquisition of the MRT Program as well as deferred tax assets recorded for net operating losses generated in 2018 that have an unlimited carryforward period. Under the Tax Act, net operating losses generated in 2018 and years thereafter can be carried forward indefinitely. As a result, the deferred tax liabilities associated with our indefinite-lived intangible assets may be used as a source of income to support the realization of the federal tax benefit of our indefinite-lived net operating losses generated in 2018. The \$2.3 million and \$4.0 million income tax benefit recognized during the three and nine months ended September 30, 2017, respectively, was due to a reduction of the same amount in the deferred tax liabilities recorded as part of our acquisition of the MRT Program. The reduction in the deferred tax liabilities during the three and nine months ended September 30, 2018 and 2017 resulted from an increase in the tax basis of the indefinite-lived IPR&D recorded in the acquisition.

The enactment of the Tax Act resulted in us recording a net income tax benefit of \$6.1 million in the year ended December 31, 2017. The \$6.1 million net income tax benefit consisted of (i) the remeasurement of the deferred tax liabilities for our indefinite-lived intangible assets due to the tax rate reduction, which resulted in a corresponding income tax benefit of \$3.7 million, and (ii) a reduction in the valuation allowance for deferred tax assets related to deductible temporary differences that will generate unlimited net operating loss carryforwards when they reverse in future periods, which resulted in a corresponding income tax benefit of \$2.4 million.

The staff of the Securities and Exchange Commission issued Staff Accounting Bulletin No. 118 to address the application of U.S. GAAP in situations when a registrant does not have the necessary information available, prepared or analyzed (including computations) in reasonable detail to complete the accounting for certain income tax effects of the Tax Act. We are still in the process of analyzing the impact to us of the Tax Act, and our analysis is not yet complete. Where we have been able to make reasonable estimates of the effects related to the Tax Act, we have recorded provisional amounts. All of our recorded income tax benefits and provisions related to the Tax Act are provisional. The ultimate impact to our condensed consolidated financial statements of the Tax Act may differ from the provisional amounts.

As of December 31, 2017, we had U.S. federal and state net operating loss carryforwards of \$124.0 million and \$102.5 million, respectively, which may be available to offset future income tax liabilities and begin to expire in 2031. As of December 31, 2017, we also had U.S. federal and state research and development tax credit carryforwards of \$3.2 million and \$1.3 million, respectively, which begin to expire in 2032 and 2027, respectively, and orphan drug tax credit carryforwards of \$2.0 million, which begin to expire in 2037. We recorded a full valuation allowance against our net deferred tax assets at December 31, 2016. As of December 31, 2017, we recorded a full valuation allowance against our deferred tax assets, except for \$2.4 million of deferred tax assets related to deductible temporary differences that will generate unlimited net operating loss carryforwards when they reverse in future periods.

Results of Operations

Comparison of the Three Months Ended September 30, 2018 and 2017

The following table summarizes our results of operations for the three months ended September 30, 2018 and 2017:

	Three Months Ended September 30,		Change
	2018	2017	
	(in thousands)		
Collaboration revenue	\$ 238	\$ —	\$ 238
Operating expenses:			
Research and development	12,933	11,097	1,836
General and administrative	5,957	3,607	2,350
Change in fair value of contingent consideration	26,829	6,132	20,697
Total operating expenses	45,719	20,836	24,883
Loss from operations	(45,481)	(20,836)	(24,645)
Other income (expense):			
Interest income	318	72	246
Other income (expense), net	(7)	—	(7)
Total other income (expense), net	311	72	239
Loss before benefit from income taxes	(45,170)	(20,764)	(24,406)
Benefit from income taxes	2,524	2,299	225
Net loss	<u>\$ (42,646)</u>	<u>\$ (18,465)</u>	<u>\$ (24,181)</u>

Collaboration Revenue

Collaboration revenue was \$0.2 million for the three months ended September 30, 2018, which was derived from the Sanofi Agreement. There was no collaboration revenue recognized in the three months ended September 30, 2017.

Research and Development Expenses

	Three Months Ended September 30,		
	2018	2017	Change
	(in thousands)		
Direct research and development expenses by program:			
CF program (including MRT5005)	\$ 3,884	\$ 3,358	\$ 526
OTC deficiency program (including MRT5201)	2,636	3,268	(632)
MRT discovery program	1,432	123	1,309
Vaccine discovery program	102	—	102
Oligonucleotide discovery program	21	186	(165)
Unallocated research and development expenses:			
Personnel related (including stock-based compensation)	3,443	2,274	1,169
Other	1,415	1,888	(473)
Total research and development expenses	<u>\$ 12,933</u>	<u>\$ 11,097</u>	<u>\$ 1,836</u>

Research and development expenses were \$12.9 million for the three months ended September 30, 2018, compared to \$11.1 million for the three months ended September 30, 2017. The increase of \$1.8 million was primarily due to increases in personnel-related costs and external research and development services costs resulting from the continued development of our MRT discovery program and advancement of our CF program into the clinic.

Direct expenses of our CF program increased by \$0.5 million in the three months ended September 30, 2018 compared to the three months ended September 30, 2017. The increase in direct expenses for the three months ended September 30, 2018 related primarily to increased raw material and manufacturing costs incurred to support our Phase 1/2 clinical trial of MRT5005 for the treatment of patients with CF, which we initiated in May 2018.

Direct expenses of our OTC deficiency program decreased by \$0.6 million in the three months ended September 30, 2018 compared to the three months ended September 30, 2017. The decrease in direct expenses for the three months ended September 30, 2018 was primarily a result of increased costs incurred in the three months ended September 30, 2017 related to preclinical development of the OTC deficiency program. Expenses for our OTC program are expected to increase over the next several years.

Direct expenses of our MRT discovery program increased by \$1.3 million in the three months ended September 30, 2018 compared to the three months ended September 30, 2017. The increase in direct expenses for the three months ended September 30, 2018 was primarily a result of increased costs related to our ongoing exploratory research in the program.

Direct expenses of our vaccine discovery program increased by \$0.1 million in the three months ended September 30, 2018 compared to the three months ended September 30, 2017 as a result of the Sanofi Agreement which was executed in July 2018. The expenses in the three months ended September 30, 2018 were related to our exploratory research in the program.

Direct expenses of our oligonucleotide discovery program decreased by \$0.2 million in the three months ended September 30, 2018 compared to the three months ended September 30, 2017 due to a shift in our focus and re-prioritization of the program in June 2017 as we continued development of our MRT platform at that time.

Unallocated research and development expenses increased by \$0.7 million in the three months ended September 30, 2018 compared to the three months ended September 30, 2017. The increase of \$1.2 million in personnel-related costs was primarily related to an increase in headcount in the three months ended September 30, 2018 compared to the same period in 2017. Additionally, there was an increase in stock-based compensation expense, resulting from options granted during the year ended December 31, 2017 and the nine months ended September 30, 2018. The decrease of \$0.5 million in other unallocated research and development expenses was the result of reductions in facilities costs due to the termination of the leases for office and laboratory spaces in Cambridge, Massachusetts in April 2018 and in Lexington, Massachusetts in June 2018.

General and Administrative Expenses

General and administrative expenses were \$6.0 million for the three months ended September 30, 2018, compared to \$3.6 million for the three months ended September 30, 2017. The increase of \$2.4 million was primarily due to increases of \$1.4 million in personnel-related costs, \$0.3 million in professional fees and \$0.3 million in insurance costs.

The \$1.4 million increase in personnel-related costs was primarily due to an increase in headcount in the three months ended September 30, 2018 compared to the three months ended September 30, 2017, as well as an increase in stock-based compensation expense, resulting from options granted during the year ended December 31, 2017 and the nine months ended September 30, 2018.

The \$0.3 million increase in professional fees was due to an increase in corporate development costs related to certain strategic planning efforts.

The \$0.3 million increase in insurance costs was a result of additional insurance coverage associated with operating as a public company.

Change in Fair Value of Contingent Consideration

In the three months ended September 30, 2018 and 2017, we recognized operating expenses of \$26.8 million and \$6.1 million, respectively, for changes in the fair value of the contingent consideration liabilities we recorded in connection with our acquisition of the MRT Program in December 2016. The contingent consideration liabilities relate to future potential milestone and earnout payment obligations and prior to the IPO, anti-dilution rights with respect to common stock issued to Shire. The \$20.7 million increase in the expense was attributed primarily to an increase in the fair value of the contingent consideration liability for future earnout payments that could become due. The increase in the fair value of contingent consideration during the three months ended September 30, 2018 was primarily due to the continued advancement of MRT5201 for which we plan to initiate a Phase 1/2 clinical trial in the first half of 2019, the time value of money due to the passage of time, as well as a decrease in the discount rate.

Benefit from Income Taxes

During the three months ended September 30, 2018 and 2017, we recognized an income tax benefit of \$2.5 million and \$2.3 million, respectively. The \$2.5 million income tax benefit recognized during the three months ended September 30, 2018 resulted from a reduction in the deferred tax liabilities recorded as part of our acquisition of the MRT Program as well as deferred tax assets recorded for net operating losses generated in 2018 that have an unlimited carryforward period. Under the Tax Act, net operating losses generated in 2018 and years thereafter can be carried forward indefinitely. As a result, the deferred tax liabilities associated with our indefinite-lived intangible assets may be used as a source of income to support the realization of the federal tax benefit of our indefinite-lived net operating losses generated in 2018. The \$2.3 million income tax benefit recognized during the three months ended September 30, 2017 was due to a reduction of the same amount in the deferred tax liabilities recorded as part of our acquisition of the MRT Program. The reduction in the deferred tax liabilities during the three months ended September 30, 2018 and 2017 resulted from an increase in the tax basis of the indefinite-lived IPR&D recorded in the acquisition.

Comparison of the Nine Months Ended September 30, 2018 and 2017

The following table summarizes our results of operations for the nine months ended September 30, 2018 and 2017:

	Nine Months Ended September 30,		Change
	2018	2017	
	(in thousands)		
Collaboration revenue	\$ 238	\$ —	\$ 238
Operating expenses:			
Research and development	40,854	34,224	6,630
General and administrative	16,726	9,706	7,020
Change in fair value of contingent consideration	39,589	10,731	28,858
Total operating expenses	97,169	54,661	42,508
Loss from operations	\$ (96,931)	\$ (54,661)	\$ (42,270)
Other income (expense):			
Interest income	499	230	269
Other income (expense), net	(52)	59	(111)
Total other income (expense), net	447	289	158
Loss before benefit from income taxes	(96,484)	(54,372)	(42,112)
Benefit from income taxes	5,126	4,020	1,106
Net loss	\$ (91,358)	\$ (50,352)	\$ (41,006)

Collaboration Revenue

Collaboration revenue was \$0.2 million for the nine months ended September 30, 2018, which was derived from the Sanofi Agreement. There was no collaboration revenue recognized in the nine months ended September 30, 2017.

Research and Development Expenses

	Nine Months Ended September 30,		Change
	2018	2017	
	(in thousands)		
Direct research and development expenses by program:			
CF program (including MRT5005)	\$ 12,498	\$ 10,774	\$ 1,724
OTC deficiency program (including MRT5201)	7,961	5,645	2,316
MRT discovery program	3,439	2,180	1,259
Vaccine discovery program	102	—	102
Oligonucleotide discovery program	100	2,246	(2,146)
Unallocated research and development expenses:			
Personnel related (including stock-based compensation)	11,356	8,412	2,944
Other	5,398	4,967	431
Total research and development expenses	<u>\$ 40,854</u>	<u>\$ 34,224</u>	<u>\$ 6,630</u>

Research and development expenses were \$40.9 million for the nine months ended September 30, 2018, compared to \$34.2 million for the nine months ended September 30, 2017. The increase of \$6.6 million was primarily due to increases in external research and development services costs resulting from the continued development of our CF and OTC deficiency programs, an increase in spending on our MRT discovery program as well as an increase in personnel-related costs, partially offset by a decrease in our oligonucleotide discovery program.

Direct expenses of our CF program increased by \$1.7 million in the nine months ended September 30, 2018 compared to the nine months ended September 30, 2017. The increase in direct expenses for the nine months ended September 30, 2018 related primarily to increased clinical trial costs related to our Phase 1/2 clinical trial of MRT5005 as well as increased manufacturing and raw material costs.

Direct expenses of our OTC deficiency program increased by \$2.3 million in the nine months ended September 30, 2018 compared to the nine months ended September 30, 2017. The increase in direct expenses for the nine months ended September 30, 2018 was primarily a result of increased manufacturing activities in anticipation a planned Phase 1/2 clinical trial of MRT5201 for the treatment of patients with OTC deficiency in the first half of 2019.

Direct expenses of our MRT discovery program increased by \$1.3 million in the nine months ended September 30, 2018 compared to the nine months ended September 30, 2017. The increase in direct expenses for the nine months ended September 30, 2018 was primarily a result of increased costs related to our ongoing exploratory research in the program.

Direct expenses of our vaccine discovery program increased by \$0.1 million in the nine months ended September 30, 2018 compared to the nine months ended September 30, 2017 as a result of the Sanofi Agreement which was executed in July 2018. The expenses in the nine months ended September 30, 2018 were related to our exploratory research in the program.

Direct expenses of our oligonucleotide discovery program decreased by \$2.1 million in the nine months ended September 30, 2018 compared to the nine months ended September 30, 2017 due to a shift in our focus and re-prioritization of the program in June 2017 as we continued development of our MRT platform at that time.

Unallocated research and development expenses increased by \$3.4 million in the nine months ended September 30, 2018 compared to the nine months ended September 30, 2017. The increase of \$2.9 million in personnel-related costs was primarily due to an increase in stock-based compensation expense, resulting from options granted during the year ended December 31, 2017 and the nine months ended September 30, 2018 and an additional \$0.3 million of expense recorded for a stock option modification that occurred in the nine months ended September 30, 2018. Additionally, there was an increase in headcount during the three months ended September 30, 2018 compared to the same period in 2017. The increase of \$0.5 million in other unallocated research and development expenses was primarily due to a \$0.3 million termination fee that we incurred to terminate a lease we acquired in connection with our acquisition of the MRT Program in December 2016.

General and Administrative Expenses

General and administrative expenses were \$16.7 million for the nine months ended September 30, 2018, compared to \$9.7 million for the nine months ended September 30, 2017. The increase of \$7.0 million was primarily due to increases of \$3.7 million in personnel-related costs, \$1.3 million in professional fees, \$0.8 million in depreciation expense and \$0.3 million in insurance costs.

The \$3.7 million increase in personnel-related costs was primarily due to an increase of \$2.3 million in stock-based compensation expense resulting from options granted during the year ended December 31, 2017 and the nine months ended September 30, 2018, as well as an increase in headcount in the nine months ended September 30, 2018 compared to the nine months ended September 30, 2017.

The \$1.3 million increase in professional fees was due to an increase in legal fees primarily associated with filing patent applications and prosecuting our intellectual property portfolio.

The \$0.8 million increase in depreciation expense was primarily due to the acceleration of unamortized leasehold improvements related to the real estate lease we acquired in connection with our acquisition of the MRT Program in December 2016 which we surrendered in June 2018.

The \$0.3 million increase in insurance costs was a result of additional insurance coverage associated with operating as a public company.

Change in Fair Value of Contingent Consideration

In the nine months ended September 30, 2018 and 2017, we recognized operating expenses of \$39.6 million and \$10.7 million, respectively, for changes in the fair value of the contingent consideration liabilities we recorded in connection with our acquisition of the MRT Program in December 2016. The contingent consideration liabilities relate to future potential milestone and earnout payment obligations and prior to the IPO, anti-dilution rights with respect to common stock issued to Shire. The \$28.9 million increase in the expense was attributed primarily to an increase in the fair value of the contingent consideration liability for future earnout payments that could be due. The increase in the fair value of contingent consideration during the nine months ended September 30, 2018 was primarily due to the continued progress of MRT5005, including the initiation in May 2018 of the Company's Phase 1/2 clinical trial of MRT5005 for the treatment of patients with CF, the continued advancement of MRT5201 for which we plan to initiate a Phase 1/2 clinical trial in the first half of 2019, the time value of money due to the passage of time, as well as a decrease in the discount rate.

Benefit from Income Taxes

During the nine months ended September 30, 2018 and 2017, we recognized an income tax benefit of \$5.1 million and \$4.0 million, respectively. The \$5.1 million income tax benefit recognized during the nine months ended September 30, 2018 resulted from a reduction in the deferred tax liabilities recorded as part of our acquisition of the MRT Program as well as deferred tax assets recorded for net operating losses generated in 2018 that have an unlimited carryforward period. Under the Tax Act, net operating losses generated in 2018 and years thereafter can be carried forward indefinitely. As a result, the deferred tax liabilities associated with our indefinite-lived intangible assets may be used as a source of income to support the realization of the federal tax benefit of our indefinite-lived net operating losses generated in 2018. The \$4.0 million income tax benefit recognized during the nine months ended September 30, 2017 was due to a reduction of the same amount in the deferred tax liabilities recorded as part of our acquisition of the MRT Program. The reduction in the deferred tax liabilities during the nine months ended September 30, 2018 and 2017 resulted from an increase in the tax basis of the indefinite-lived IPR&D recorded in the acquisition.

Liquidity and Capital Resources

Since our inception, we have generated limited revenue to date from the Sanofi Agreement and have incurred significant operating losses and negative cash flows from our operations. We have not generated any revenue from product sales. We have not yet commercialized any of our product candidates, and we do not expect to generate revenue from sales of any product candidates for several years, if at all. We have funded our operations primarily with proceeds from the sale of redeemable convertible preferred stock and the sale of bridge units, which ultimately converted into shares of our preferred stock, the proceeds from our IPO and an upfront payment received under the Sanofi Agreement. Through September 30, 2018, we had received net cash proceeds of \$189.2 million from sales of our preferred stock and bridge units and \$45.0 million in an upfront payment from Sanofi.

On June 27, 2018, our registration statement on Form S-1 relating to our IPO was declared effective by the SEC. In the IPO, which closed on July 2, 2018, we issued and sold 9,350,000 shares of common stock at a public offering price of \$13.00 per share. On July 24, 2018, we issued and sold an additional 364,371 shares of common stock at a price of \$13.00 per share pursuant to the exercise of the underwriters' over-allotment option in the IPO. The aggregate net proceeds we received from the IPO, inclusive of the proceeds from the over-allotment exercise, were \$113.2 million after deducting underwriting discounts and commissions of \$8.8 million and offering expenses of \$4.3 million. Upon closing of the IPO, all 142,288,292 shares of our redeemable convertible preferred stock then outstanding converted into an aggregate of 25,612,109 shares of common stock.

Cash Flows

The following table summarizes our sources and uses of cash for each of the periods presented:

	Nine Months Ended September 30,	
	2018	2017
	(in thousands)	
Net cash used in operating activities	\$ (5,889)	\$ (37,518)
Net cash used in investing activities	(117,882)	(12,475)
Net cash provided by financing activities	113,636	—
Net decrease in cash, cash equivalents and restricted cash	<u>\$ (10,135)</u>	<u>\$ (49,993)</u>

Operating Activities

During the nine months ended September 30, 2018, operating activities used \$5.9 million of cash, resulting from our net loss of \$91.4 million, partially offset by net cash provided by changes in our operating assets and liabilities of \$43.4 million and by net non-cash charges of \$42.1 million. Net cash used by changes in our operating assets and liabilities for the nine months ended September 30, 2018 consisted of a \$44.8 million increase in deferred revenue resulting from the \$45.0 million received under Sanofi Agreement, which was effective in July 2018, partially offset by a \$1.6 million increase in prepaid expenses and a \$1.6 million decrease in accounts payable. Net non-cash charges for the nine months ended September consisted of a \$39.6 increase in the change in fair value of contingent consideration which was primarily due to the continued progress of MRT5005, including the initiation in May 2018 of the Company's Phase 1/2 clinical trial for the treatment of patients with CF as well as a decrease in the discount rate.

During the nine months ended September 30, 2017, operating activities used \$37.5 million of cash, resulting from our net loss of \$50.4 million, partially offset by net non-cash charges of \$9.1 million and net cash provided by changes in our operating assets and liabilities of \$3.8 million. Net cash provided by changes in our operating assets and liabilities for the nine months ended September 30, 2017 consisted primarily of a \$2.2 million increase in accrued expenses, a \$1.9 million increase in accounts payable and a \$0.6 million increase in deferred rent, all partially offset by a \$0.9 million increase in prepaid expenses and other assets.

Investing Activities

During the nine months ended September 30, 2018, net cash used in investing activities was \$117.9 million, consisting of \$128.3 million of purchases of short-term investments as well as \$5.6 million of purchases of property and equipment, which primarily consisted of leasehold improvements and other property and equipment related to the lease of our new headquarters in Lexington, Massachusetts, partially offset by \$16.0 million of sales and maturities of short-term investments.

During the nine months ended September 30, 2017, net cash used in investing activities was \$12.5 million, consisting of \$65.8 million of purchases of short-term investments and \$0.6 million of purchases of property and equipment, both partially offset by \$53.9 million of sales and maturities of short-term investments.

Financing Activities

During the nine months ended September 30, 2018, net cash provided by financing activities was \$113.6 million, consisting of net proceeds from our IPO, inclusive of the proceeds from the over-allotment exercise, of \$113.4 million after deducting underwriting discounts and commissions and offering expenses.

During the nine months ended September 30, 2017, we had no cash flows from financing activities.

Funding Requirements

We expect our expenses to increase in connection with our ongoing activities, particularly as we continue the research and development of, initiate clinical trials of and seek marketing approval for our product candidates. In addition, we expect to incur additional costs associated with operating as a public company. Our expenses will also increase if, and as, we:

- leverage our programs to advance our other product candidates into preclinical and clinical development;
- seek regulatory approvals for any product candidates that successfully complete clinical trials;
- seek to discover and develop additional product candidates;
- establish a sales, marketing, medical affairs and distribution infrastructure to commercialize any product candidates for which we may obtain marketing approval and intend to commercialize on our own or jointly;
- hire additional clinical, quality control and scientific personnel;
- expand our operational, financial and management systems and increase personnel, including personnel to support our clinical development, manufacturing and commercialization efforts and our operations as a public company;
- maintain, expand and protect our intellectual property portfolio; and
- acquire or in-license other product candidates and technologies.

We believe that our existing cash, cash equivalents and short-term investments will enable us to fund our operating expenses and capital expenditure requirements into the first half of 2020. We have based this estimate on assumptions that may prove to be wrong, and we could exhaust our available capital resources sooner than we expect.

Because of the numerous risks and uncertainties associated with research, development and commercialization of product candidates, we are unable to estimate the exact amount of our working capital requirements. Our future funding requirements will depend on, and could increase significantly as a result of, many factors, including:

- the scope, progress, results and costs of researching and developing our product candidates, and conducting preclinical studies and clinical trials;
- the costs, timing and outcome of regulatory review of our product candidates;
- the costs of future activities, including product sales, medical affairs, marketing, manufacturing and distribution, for any of our product candidates for which we receive marketing approval;
- the costs of manufacturing commercial-grade products and sufficient inventory to support commercial launch;
- the ability to receive additional non-dilutive funding, including grants from organizations and foundations;
- the revenue, if any, received from commercial sale of our products, should any of our product candidates receive marketing approval;
- the cost and timing of hiring new employees to support our continued growth;
- the costs of preparing, filing and prosecuting patent applications, maintaining and enforcing our intellectual property rights and defending intellectual property-related claims;
- the ability to establish and maintain collaborations on favorable terms, if at all;
- the extent to which we acquire or in-license other product candidates and technologies; and
- the timing, receipt and amount of sales of, or milestone payments related to or royalties on, our current or future product candidates, if any.

A change in the outcome of any of these or other variables with respect to the development of any of our product candidates could significantly change the costs and timing associated with the development of that product candidate. Further, our operating plans

may change in the future, and we may need additional funds to meet operational needs and capital requirements associated with such operating plans.

Until such time, if ever, as we can generate substantial product revenue, we expect to finance our cash needs through a combination of public or private equity offerings, debt financings, collaborations, strategic partnerships or marketing, distribution or licensing arrangements with third parties and grants from organizations and foundations. To the extent that we raise additional capital through the sale of equity or convertible debt securities, the ownership interests of our common stockholders may be materially diluted, and the terms of such securities could include liquidation or other preferences that could adversely affect the rights of our common stockholders. Debt financing and preferred equity financing, if available, may involve agreements that include restrictive covenants that limit our ability to take specified actions, such as incurring additional debt, making capital expenditures or declaring dividends. In addition, debt financing would result in increased fixed payment obligations.

If we raise funds through collaborations, strategic partnerships or marketing, distribution or licensing arrangements with third parties, we may have to relinquish valuable rights to our technologies, future revenue streams, research programs or product candidates or grant licenses on terms that may not be favorable to us.

If we are unable to raise additional funds when needed, we may be required to delay, reduce or eliminate our product development or future commercialization efforts, or grant rights to develop and market product candidates that we would otherwise prefer to develop and market ourselves.

Contractual Obligations and Commitments

The disclosure of contractual obligations and commitments is set forth under the heading “Management’s Discussion and Analysis of Financial Condition and Results of Operations—Contractual Obligations and Commitments” in our Prospectus. See Note 14 to our unaudited condensed financial statements included in Item 1, “Unaudited Financial Statements,” of this Quarterly Report on Form 10-Q for a discussion of obligations and commitments. During the three months ended September 30, 2018, there were no material changes to our contractual obligations and commitments as of March 31, 2018 described under Management’s Discussion and Analysis of Financial Condition and Results of Operations in the Prospectus, with the exception of our master supply agreement with Roche Diagnostics Corporation, which was amended in September 2018. The agreement, as amended, specifies a minimum purchase requirement for certain custom manufactured products. As of September 30, 2018, the Company’s purchase commitments under the amended agreement totaled \$24.0 million, with \$9.6 million committed as payments in 2019, \$0.5 million committed as payments in 2020 and \$3.5 million committed as payments each year from 2021 to 2024.

Critical Accounting Policies and Significant Judgments and Estimates

Our management’s discussion and analysis of financial condition and results of operations is based on our financial statements, which have been prepared in accordance with generally accepted accounting principles in the United States. The preparation of our financial statements and related disclosures requires us to make estimates and assumptions that affect the reported amounts of assets and liabilities, costs and expenses, revenues and the disclosure of contingent assets and liabilities in our financial statements. Please refer to Note 1 to our condensed consolidated financial statements included in Part I, Item 1, “Financial Statements (Unaudited),” of this Quarterly Report on Form 10-Q. We base our estimates on historical experience, known trends and events and various other factors that we believe are reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. We evaluate our estimates and assumptions on an ongoing basis. Our actual results may differ from these estimates under different assumptions or conditions.

During the three and nine months ended September 30, 2018, there were no material changes to our critical accounting policies. Our critical accounting policies are described under the heading “Management’s Discussion and Analysis of Financial Condition and Results of Operations—Critical Accounting Policies and Significant Judgements and Estimates” in our Prospectus and the notes to the unaudited condensed financial statements included in Item 1, “Financial Statements (Unaudited),” of this Quarterly Report on Form 10-Q.

Emerging Growth Company Status

The Jumpstart Our Business Startups Act of 2012 permits an “emerging growth company” such as us to take advantage of an extended transition period to comply with new or revised accounting standards applicable to public companies until those standards would otherwise apply to private companies. We have irrevocably elected to “opt out” of this provision and, as a result, we will comply with new or revised accounting standards when they are required to be adopted by public companies that are not emerging growth companies.

Off-Balance Sheet Arrangements

We did not have during the periods presented, and we do not currently have, any off-balance sheet arrangements, as defined in the rules and regulations of the Securities and Exchange Commission.

Item 3. Quantitative and Qualitative Disclosures About Market Risk.

Interest Rate Risk

As of September 30, 2018 and December 31, 2017, we had cash equivalents consisting of money market funds and short-term investments consisting of U.S. government agency bonds that have contractual maturities of less than one year. Our primary exposure to market risk is interest income sensitivity, which is affected by changes in the general level of U.S. interest rates. However, because of the short-term nature of the investments in our portfolio, an immediate 10% change in market interest rates would not have a material impact on the fair market value of our investment portfolio or on our financial position or results of operations.

As of September 30, 2018 and December 31, 2017, we had no debt outstanding and are therefore not exposed to interest rate risk with respect to debt.

Foreign Currency Exchange Risk

All of our employees and our operations are currently located in the United States. We have, from time to time, engaged in contracts with contractors or other vendors in a currency other than the U.S. dollar. To date, we have had minimal exposure to fluctuations in foreign currency exchange rates as the time period between the date that transactions are initiated and the date of payment or receipt of payment is generally of short duration. Accordingly, we believe we do not have a material exposure to foreign currency risk.

Item 4. Controls and Procedures.

Evaluation of Disclosure Controls and Procedures

We maintain “disclosure controls and procedures” as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934, as amended, or the Exchange Act, that are designed to ensure that information required to be disclosed in the reports we file and submit under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in the SEC’s rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by us in the reports we file or submit under the Exchange Act is accumulated and communicated to our management, including our principal executive officer and principal financial officer, as appropriate to allow timely decisions regarding required disclosure. In designing and evaluating our disclosure controls and procedures, management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives, and management necessarily applies its judgment in evaluating the benefits of possible controls and procedures relative to their costs.

Our management, with the participation of our Chief Executive Officer and Chief Financial Officer, who serve as our principal executive officer and principal financial and accounting officer, respectively, has evaluated the effectiveness of our disclosure controls and procedures as of September 30, 2018. In making this evaluation, our management considered the material weakness in our internal control over financial reporting described below. Based on such evaluation, our Chief Executive Officer and Chief Financial Officer have concluded that our disclosure controls and procedures were not effective as of such date.

A material weakness is a deficiency, or a combination of deficiencies, in internal control over financial reporting, such that there is a reasonable possibility that a material misstatement of the financial statements will not be prevented or detected on a timely basis. Management has identified the following material weakness, which has caused management to conclude that, as of September 30, 2018, our disclosure controls and procedures were not effective: we did not design and maintain effective controls and procedures over our accounting for and reporting of the income tax impacts of business combinations in fiscal 2016, and such deficiency has remained unremediated as of September 30, 2018.

Notwithstanding the assessment that our internal controls and procedures were not effective, we believe that our financial statements contained in this Quarterly Report on Form 10-Q fairly present our financial position, results of operations and cash flows for the years and months covered thereby in all material respects.

Remediation Plans

In response to the material weakness describe above, we designed and implemented new internal controls and procedures over the accounting for and reporting of the tax impact of complex business transactions. The material weakness will not be considered remediated until the newly implemented controls operate for a sufficient period of time and management has concluded, through testing, that these controls are operating effectively.

Changes in Internal Control over Financial Reporting

The change described in “Remediation Plans” above was considered a change in our internal control over financial reporting (as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act) that occurred during the three months ended September 30, 2018 that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

PART II—OTHER INFORMATION

Item 1. Legal Proceedings.

We are not currently subject to any material legal proceedings.

Item 1A. Risk Factors.

Investing in our common stock involves a high degree of risk. Before investing in our common stock, you should consider carefully the risks described below, together with the other information contained in this Quarterly Report on Form 10-Q, including our financial statements and the related notes and in our other filings with the Securities and Exchange Commission. If any of the following risks occur, our business, financial condition, results of operations and prospects could be materially and adversely affected. In these circumstances, the market price of our common stock could decline, and you may lose all or part of your investment.

Risks Related to our Financial Position and Need for Additional Capital

We have incurred significant losses since inception. We expect to incur losses for at least the next several years and may never achieve or maintain profitability.

Since inception, we have incurred significant losses. Our net losses were \$91.4 million and \$66.4 million for the nine months ended September 30, 2018 and year ended December 31, 2017, respectively. As of September 30, 2018, we had an accumulated deficit of \$240.2 million. We have funded our operations to date primarily with proceeds from the sale of redeemable convertible preferred stock and the sale of bridge units, which ultimately converted into shares of our preferred stock, the proceeds from our IPO and an upfront payment received under the Sanofi Agreement. We expect that it could be several years, if ever, before we have a commercialized product candidate. We expect to continue to incur significant expenses and operating losses for the foreseeable future. The net losses we incur may fluctuate significantly from quarter to quarter. We anticipate that our expenses will increase substantially if, and as, we:

- pursue the clinical development of MRT5005 and MRT5201, our lead product candidates;
- leverage our programs to advance our other product candidates into preclinical and clinical development;
- seek regulatory approvals for any product candidates that successfully complete clinical trials;
- seek to discover and develop additional product candidates;
- establish a sales force, marketing, medical affairs and distribution infrastructure to commercialize any product candidates for which we may obtain marketing approval and intend to commercialize on our own or jointly;
- hire additional clinical, quality control and scientific personnel;
- expand our operational, financial and management systems and increase personnel, including personnel to support our clinical development, manufacturing and commercialization efforts and our operations as a public company;
- maintain, expand and protect our intellectual property portfolio;
- acquire or in-license other product candidates and technologies; and
- incur additional legal, accounting and other expenses in operating as a public company.

To become and remain profitable, we, or our collaborators, must develop and eventually commercialize product candidates with significant market potential. This will require us to succeed in a range of challenging activities, including completing preclinical studies and clinical trials of our product candidates, obtaining marketing approval for these product candidates, manufacturing, marketing and selling those products for which we may obtain marketing approval and satisfying any post-marketing requirements. We may never succeed in any or all of these activities and, even if we do, we may never generate sufficient revenue to achieve profitability. If we do achieve profitability, we may not be able to sustain or increase profitability on a quarterly or annual basis. Our failure to become and remain profitable 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 have never generated revenue from product sales and may never be profitable.

We have never generated revenue from product sales. Our ability to generate revenue from product sales and achieve profitability depends on our ability, alone or with our collaborative partners, to successfully develop and obtain the regulatory approvals necessary to commercialize our product candidates. We do not have any products approved for sale and do not anticipate generating revenue from product sales for the next several years, if ever. Our ability to generate future revenue from product sales depends heavily on our, or our collaborators', success in:

- completing preclinical and clinical development of our product candidates and identifying and developing new product candidates;
- seeking and obtaining marketing approvals for any of our product candidates;
- launching and commercializing product candidates for which we obtain marketing approval by establishing a sales force, marketing, medical affairs and distribution infrastructure or, alternatively, collaborating with a commercialization partner;
- achieving formulary status in hospitals and adequate coverage and reimbursement by government and third party payors for our product candidates;
- establishing and maintaining supply and manufacturing relationships with third parties that can provide adequate, in both amount and quality, products and services to support clinical development and the market demand for our product candidates, if approved;
- obtaining market acceptance of our product candidates as viable treatment options;
- addressing any competing technological and market developments;
- negotiating favorable terms in any collaboration, licensing or other arrangements into which we may enter and performing our obligations in such collaborations;
- maintaining, protecting and expanding our portfolio of intellectual property rights, including patents, trade secrets and know-how;
- defending against third-party interference or infringement claims, if any; and
- attracting, hiring and retaining qualified personnel.

Even if one or more of the product candidates that we develop is approved for commercial sale, we anticipate incurring significant costs in commercializing any approved product candidate. Our expenses could increase beyond expectations if we are required by the U.S. Food and Drug Administration, or FDA, the European Medicines Agency, or EMA, or other regulatory agencies to perform clinical trials or studies in addition to those that we currently anticipate. Even if we are able to generate revenue from the sale of any approved products, we may not become profitable and may need to obtain additional funding to continue operations.

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.

Our operations to date have been limited to organizing and staffing our company, business planning, raising capital, acquiring or discovering product candidates and securing related intellectual property rights, conducting discovery, research and development activities for our programs, undertaking preclinical studies, entering into licensing agreements and planning for potential commercialization. While we have initiated a Phase 1/2 clinical trial of MRT5005 and plan to initiate a Phase 1/2 clinical trial of MRT5201, we have not yet completed a clinical trial of any of our product candidates. We have not yet demonstrated the ability to initiate or conduct clinical trials, obtain marketing approvals, manufacture a commercial-scale product or conduct sales and marketing activities necessary for successful commercialization. Consequently, any evaluation of our business to date or predictions about our future success or viability may not be as accurate as they could be if we had a longer operating history.

If we obtain marketing approval for any of our product candidates, we will need to transition from a company with a research and development focus to a company capable of supporting commercial activities. We may encounter unforeseen expenses, difficulties, complications and delays and may not be successful in such a transition.

We will need to raise additional funding, which may not be available on acceptable terms, or at all. Failure to obtain capital when needed may force us to delay, reduce or eliminate certain of our product development efforts or other operations.

We expect our expenses to increase in connection with our ongoing activities, particularly as we continue the research and development of, initiate clinical trials of and seek marketing approval for our product candidates. These expenditures will include costs associated with our asset purchase agreement, as amended, with Shire Human Genetic Therapies, Inc., or Shire, a subsidiary of Shire plc, or the Shire Agreement. Under the terms of the Shire Agreement, we are obligated to make significant cash payments upon the achievement of specified commercial milestones, as well as earnout payments in connection with sales of products based on the compounds that we acquired from Shire.

We will require additional capital to advance MRT5005 and MRT5201 and any other product candidates we develop through necessary clinical trials and clinical development. In addition, if we obtain marketing approval for any of our product candidates that we plan to commercialize ourselves, we expect to incur significant expenses related to product sales, medical affairs, marketing, manufacturing and distribution. Furthermore, we expect to incur additional costs associated with operating as a public company. Accordingly, we will need to obtain additional funding in connection with our continuing operations. We may raise this additional funding through the sale of equity, debt financings or other capital sources, including potential collaborations with other companies or other strategic transactions and funding under government or other contracts. In addition, we may seek additional capital due to favorable market conditions or strategic considerations, even if we believe we have sufficient funds for our current or future operating plans.

We believe that our existing cash, cash equivalents and short-term investments will enable us to fund our operating expenses and capital expenditure requirements into the first half of 2020. To finance our operations beyond that point, we will need to raise additional capital, which cannot be assured.

Our estimates regarding our ability to fund our operating expenses and capital expenditure requirements with our existing cash, cash equivalents and short-term investments are based on assumptions that may prove to be wrong, and we could exhaust our available capital resources sooner than we expect. Our future funding requirements will depend on, and could increase significantly as a result of, many factors, including:

- the scope, progress, results and costs of researching and developing our product candidates, and conducting preclinical studies and clinical trials;
- the costs, timing and outcome of regulatory review of our product candidates;
- the costs of future activities, including product sales, medical affairs, marketing, manufacturing and distribution, for any of our product candidates for which we receive marketing approval;
- the costs of manufacturing commercial-grade products and sufficient inventory to support commercial launch;
- the success of our collaboration with Sanofi;
- the ability to receive additional non-dilutive funding, including grants from organizations and foundations;
- the revenue, if any, received from commercial sale of our products, should any of our product candidates receive marketing approval;
- the cost and timing of hiring new employees to support our continued growth;
- costs of preparing, filing and prosecuting patent applications, maintaining and enforcing our intellectual property rights and defending intellectual property-related claims;
- our ability to establish and maintain collaborations on favorable terms, if at all;
- the extent to which we acquire or in-license other product candidates and technologies; and
- the timing, receipt and amount of sales of, or milestone payments related to or royalties on, our current or future product candidates, if any.

Identifying potential product candidates and conducting preclinical studies and clinical trials is a time-consuming, expensive and uncertain process that typically takes years to complete, and we may never generate the necessary data or results required to obtain marketing approval and achieve product sales. In addition, our product candidates, if approved, may not achieve commercial success. Our product revenue, if any, and any commercial milestones or royalty payments under any collaboration agreements that we enter into, including our collaboration with Sanofi, will be derived from or based on sales of products that may not be commercially available for many years, if at all. Accordingly, we will continue to rely on additional financing to achieve our business objectives.

Any additional fundraising efforts may divert our management from their day-to-day activities, which may adversely affect our ability to develop and commercialize our product candidates. We cannot guarantee that future financing will be available in sufficient amounts or on terms acceptable to us, if at all. Our issuance of additional securities, whether equity or debt, or the possibility of such

issuance, may cause the market price of our common stock to decline, and our stockholders may not agree with our financing plans or the terms of such financings.

Our failure to raise capital as and when needed would negatively impact our financial condition and our ability to pursue our business strategy, and we could be forced to delay, reduce or eliminate certain of our research and development programs or any future commercialization efforts.

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

Until such time, if ever, as we can generate substantial product revenue, we expect to finance our cash needs through the combination of public or private equity offerings, debt financings, grants, collaborations, strategic partnerships or marketing, distribution or licensing arrangements with third parties. To the extent that we raise additional capital through the sale of equity or convertible debt securities, your ownership interest may be materially diluted, and the terms of such securities could include liquidation or other preferences that adversely affect your rights as a common stockholder. Debt financing and preferred equity financing, if available, may involve agreements that include restrictive covenants that limit our ability to take specified actions, such as incurring debt, making capital expenditures or declaring dividends. In addition, debt financing would result in increased fixed payment obligations.

If we raise funds through collaborations, strategic partnerships or marketing, distribution or licensing arrangements with third parties, we may have to relinquish valuable rights to our technologies, future revenue streams, research programs or product candidates or to grant licenses on terms that may not be favorable to us. If we are unable to raise additional funds when needed, we will be required to delay, reduce or eliminate our product development or future commercialization efforts or grant rights to develop and market product candidates that we would otherwise prefer to develop and market ourselves.

We may be required to make payments in connection with our acquisition of the MRT Program from Shire.

In December 2016, we acquired the messenger RNA, or mRNA, therapeutic platform, or MRT Program, pursuant to the Shire Agreement. Under the Shire Agreement, we are obligated to make milestone payments to Shire of up to \$60.0 million in the aggregate upon the occurrence of specified commercial milestones, including upon the first commercial sale of a product that includes or is composed of MRT compounds acquired from Shire, or MRT Product, for the treatment of cystic fibrosis, or CF, and upon the achievement of a specified level of annual net sales with respect to MRT Products. We are also obligated to make additional milestone payments of \$10.0 million for each non-CF MRT Product upon the first commercial sale of a non-CF MRT Product; provided that such milestone payments will only be due once for any two non-CF MRT Products that contain the same MRT compounds or once per non-CF MRT Product that is a vaccine developed under our collaboration with Sanofi. Under the Shire Agreement, we are also obligated to pay a fixed, quarterly earnout payment of a mid-single-digit percentage of net sales of each MRT Product. The earnout period will begin on the date of the first commercial sale of MRT Products and will end, on a product-by-product and country-by-country basis, on the later of (1) the expiration of the last valid claim of the assigned patents covering the manufacture, use or composition of such product in such country of the applicable MRT Product and (2) ten years after the first commercial sale of the MRT Product in such country. If these payments become due under the terms of the Shire Agreement, we may not have sufficient funds available to meet our obligations and our development efforts may be materially harmed. If a combination MRT Product that is a vaccine is sold, in certain circumstances, we would be obligated to pay Shire a royalty on a minimum portion of net sales.

Comprehensive tax reform legislation could adversely affect our business and financial condition.

On December 22, 2017, the U.S. government enacted the Tax Cuts and Jobs Act, which significantly reforms the Internal Revenue Code of 1986, as amended. The newly enacted federal income tax law, among other things, contains significant changes to corporate taxation, including reduction of the corporate tax rate from a top marginal rate of 35% to a flat rate of 21%, limitation of the tax deduction for net interest expense to 30% of adjusted earnings (except for certain small businesses), limitation of the deduction for net operating losses to 80% of annual taxable income and elimination of net operating loss carrybacks, in each case, for losses arising in taxable years beginning after December 31, 2017 (though any such net operating losses may be carried forward indefinitely), one-time taxation of offshore earnings at reduced rates regardless of whether they are repatriated, elimination of U.S. tax on foreign earnings (subject to certain important exceptions), immediate deductions for certain new investments instead of deductions for depreciation expense over time, and modifying or repealing many business deductions and credits. Notwithstanding the reduction in the corporate income tax rate, the overall impact of the new federal tax law is uncertain and our business and financial condition could be adversely affected. In addition, it is uncertain how various states will respond to the newly enacted federal tax law. The impact of this tax reform on holders of our common stock is also uncertain and could be adverse. We urge prospective investors in our common stock to consult with their legal and tax advisors with respect to this legislation and the potential tax consequences of investing in or holding our common stock.

We might not be able to utilize a significant portion of our net operating loss carryforwards and research and development tax credit carryforwards.

As of December 31, 2017, we had federal and state net operating loss carryforwards of \$124.0 million and \$102.5 million, respectively, which will, if not utilized, each begin to expire in 2031; federal and state research and development tax credit carryforwards of \$3.2 million and \$1.3 million, respectively, which will, if not utilized, begin to expire in 2032 and 2027, respectively; and orphan drug tax credit carryforwards of \$2.0 million, which will, if not utilized, begin to expire in 2037. These net operating loss and tax credit carryforwards could expire unused and be unavailable to offset our future income tax liabilities. Under the newly enacted federal income tax law, federal net operating losses incurred in 2018 and in future years may be carried forward indefinitely, but the deductibility of such federal net operating losses is limited. It is uncertain how various states will respond to the newly enacted federal tax law.

In addition, under Section 382 of the Internal Revenue Code of 1986, as amended, and corresponding provisions of state law, if a corporation undergoes an "ownership change," which is generally defined as a greater than 50% change, by value, in its equity ownership over a three-year period, the corporation's ability to use its pre-change net operating loss carryforwards and other pre-change tax attributes to offset its post-change income may be limited. We have not determined if we have experienced Section 382 ownership changes in the past and if a portion of our net operating loss and tax credit carryforwards are subject to an annual limitation under Section 382. In addition, we may experience ownership changes in the future as a result of subsequent changes in our stock ownership, some of which may be outside of our control. If we determine that an ownership change has occurred and our ability to use our historical net operating loss and tax credit carryforwards is materially limited, it would harm our future operating results by effectively increasing our future tax obligations.

Risks Related to the Development of Our Product Candidates

Our approach to the discovery and development of product candidates based on mRNA is unproven, and we do not know whether we will be able to successfully develop any products.

We focus on delivering mRNA encoding functional versions of proteins into cells without altering the underlying DNA. Our future success depends on the successful development of this novel therapeutic approach. Relatively few mRNA-based therapeutic product candidates have been tested in animals or humans, and the data underlying the feasibility of developing mRNA-based therapeutic products is both preliminary and limited. To date, no product that utilizes mRNA as a therapeutic has been approved in the United States or Europe. We have not yet succeeded and may not succeed in demonstrating the efficacy and safety of any of our product candidates in clinical trials or in obtaining marketing approval thereafter. We have not yet completed a clinical trial of any product candidate and we have not yet assessed safety of any product candidate in humans. As such, there may be adverse effects from treatment with any of our current or future product candidates that we cannot predict at this time.

As a result of these factors, it is more difficult for us to predict the time and cost of product candidate development, and we cannot predict whether the application of our MRT platform, or any similar or competitive mRNA platforms, will result in the development and regulatory approval of any products. There can be no assurance that any development problems we experience in the future related to our MRT platform or any of our research programs will not cause significant delays or unanticipated costs, or that such development problems can be solved. Any of these factors may prevent us from completing our preclinical studies or any clinical trials that we may initiate or commercializing any product candidates we may develop on a timely or profitable basis, if at all.

We have never obtained marketing approval for a product candidate, and we may be unable to obtain, or may be delayed in obtaining, marketing approval for any of our product candidates.

We are a clinical-stage company and have not received approval from the FDA, EMA or other regulatory authority to market any product candidate. The regulatory review process may be more expensive or take longer than we expect, and we may be required to conduct additional studies and/or trials beyond those we anticipate. If it takes us longer to develop and/or obtain regulatory approval for our product candidates than we expect, such delays could materially and adversely affect our business, financial condition, results of operations and prospects.

In the near term, we are dependent on the success of MRT5005 and MRT5201. If we are unable to initiate or complete the clinical development of, obtain marketing approval for or successfully commercialize MRT5005 and MRT5201, either alone or with a future collaborator, or if we experience significant delays in doing so, our business would be substantially harmed.

We do not currently have products approved for sale and are investing a significant portion of our efforts and financial resources in the development of MRT5005 and MRT5201. Our prospects are substantially dependent on our ability, or that of any future collaborator, to develop and obtain marketing approval for, and successfully commercialize, MRT5005 and MRT5201 in one or more disease indications.

The success of MRT5005 and MRT5201 will depend on several factors, including the following:

- successful initiation of clinical trials;

- successful patient enrollment in and completion of clinical trials;
- a safety, tolerability and efficacy profile that is satisfactory to the FDA, EMA or other regulatory authorities for marketing approval;
- timely receipt of marketing approvals from applicable regulatory authorities;
- the extent of any required post-marketing approval commitments to applicable regulatory authorities;
- establishment and maintenance of arrangements with third-party manufacturers for both clinical and any future commercial manufacturing;
- adequate ongoing availability of raw materials and drug product for clinical development and any commercial sales;
- obtaining and maintaining patent, trade secret protection and regulatory exclusivity, both in the United States and internationally;
- protection of our rights in our intellectual property portfolio;
- successful launch of commercial sales following any marketing approval;
- a continued acceptable safety profile following any marketing approval;
- commercial acceptance by hospitals, the patient community, the medical community and third-party payors;
- the availability of coverage and adequate reimbursement from third-party payors;
- the performance of our future collaborators, if any; and
- our ability to compete with other therapies.

Many of these factors are beyond our control, including clinical development, the regulatory review process, potential threats to our intellectual property rights and the manufacturing, marketing and sales efforts of any future collaborator. If we are unable to develop, receive marketing approval for and successfully commercialize MRT5005 and MRT5201, on our own or with any future collaborator, or experience delays as a result of any of these factors or otherwise, our business would be substantially harmed.

Clinical drug development is a lengthy and expensive process with uncertain timelines and uncertain outcomes. If the initiation or completion of clinical trials of our product candidates, particularly MRT5005 and MRT5201, is prolonged or delayed, we or any future collaborators may be unable to obtain required regulatory approvals, and therefore will be unable to commercialize our product candidates on a timely basis or at all, which will adversely affect our business.

Before obtaining marketing approval for our product candidates, we must complete preclinical development and then conduct extensive clinical trials to demonstrate the safety and efficacy of the product candidates. Clinical testing is expensive, time-consuming, difficult to design and implement and uncertain as to outcome. We cannot guarantee that our clinical trials, such as our Phase 1/2 clinical trial of MRT5005 in patients with CF, will be conducted as planned, completed on schedule, if at all, or yield positive results.

A clinical trial failure can occur at any stage of testing. Events that may prevent successful or timely completion of clinical development include:

- delays in reaching a consensus with regulatory authorities or collaborators on trial design;
- delays in reaching agreement on acceptable terms with contract research organizations, or CROs, and clinical trial sites;
- delays in opening clinical trial sites or obtaining required institutional review board or independent ethics committee approval at each clinical trial site;
- delays in recruiting suitable subjects or a sufficient number of subjects to participate in our clinical trials;
- imposition of a clinical hold by regulatory authorities, including upon submission of an IND, such as the clinical hold that the FDA had placed on the IND for our clinical trial of MRT5005 and subsequently lifted in April 2018, or as a result of a serious adverse event or after an inspection of our clinical trial operations or trial sites;
- failure by us, any CROs we engage, clinical investigators or any other third parties to adhere to clinical trial requirements;
- failure to perform the clinical trial in accordance with good clinical practices, or GCP, or applicable regulatory requirements in the European Union, the United States, or other countries;
- delays in the testing, validation, manufacturing and delivery of our product candidates to the clinical sites, including delays by third parties with whom we have contracted to perform certain of those functions;

- delays or failures in demonstrating the comparability of product manufactured at one facility or with one process to product manufactured at another facility or with another process, including clinical trials to demonstrate such comparability;
- delays in having patients complete participation in a trial or return for post-treatment follow-up;
- clinical trial sites or subjects dropping out of a trial;
- selection of clinical endpoints that require prolonged periods of clinical observation or analysis of the resulting data;
- occurrence of serious adverse events associated with the product candidate that are viewed to outweigh its potential benefits;
- occurrence of serious adverse events in trials of the same class of agents conducted by other sponsors; and
- changes in regulatory requirements and guidance that require amending or submitting new clinical protocols.

Any inability to successfully complete preclinical and clinical development could result in additional costs to us or impair our ability to generate revenue from product sales, regulatory and commercialization milestones and royalties. In addition, if we make manufacturing or formulation changes to our product candidates, we may need to conduct additional trials to bridge our modified product candidates to earlier versions. Clinical trial delays also could shorten any periods during which we may have the exclusive right to commercialize our product candidates or 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, financial condition, results of operations and prospects.

We could encounter delays if a clinical trial is suspended or terminated by us, by the institutional review boards of the institutions in which such trials are conducted or their ethics committees, by the Data Review Committee or Data Safety Monitoring Board for such trial or by the FDA or other foreign regulatory authorities. Such authorities may suspend or terminate a clinical trial due to a number of factors, including failure to conduct the clinical trial in accordance with regulatory requirements or our clinical protocols, inspection of the clinical trial operations or trial site by the FDA or other foreign regulatory authorities resulting in the imposition of a clinical hold, unforeseen safety issues or adverse side effects, including those relating to the class of products to which our product candidates belong.

Any of these occurrences may harm our business, financial condition and prospects significantly. In addition, many of the factors that cause or lead to a delay in the commencement or completion of clinical trials may also ultimately lead to the denial of regulatory approval of our product candidates or early termination of the development of our product candidates.

Preclinical drug development is uncertain. Some or all of our preclinical programs may experience delays or may never advance to clinical trials, which would adversely affect our ability to obtain regulatory approvals or commercialize these product candidates on a timely basis or at all, which would have an adverse effect on our business.

In order to obtain FDA approval to market a new biological product, we must demonstrate proof of safety, purity and potency or efficacy in humans. To satisfy these requirements, we will have to conduct adequate and well-controlled clinical trials. Before we can commence clinical trials for a product candidate, we must complete extensive preclinical testing and studies that support our planned IND in the United States. We cannot be certain of the timely completion or outcome of our preclinical testing and studies, and we cannot predict if the FDA will accept our proposed clinical programs or if the outcome of our preclinical testing and studies will ultimately support the further development of these product candidates. As a result, we cannot be sure that we will be able to submit INDs or similar applications for any preclinical programs on the timelines we expect, if at all, and we cannot be sure that submission of INDs or similar applications will result in the FDA or other regulatory authorities allowing clinical trials to begin. For example, after we submitted an IND for MRT5005 to initiate our Phase 1/2 clinical trial in patients with CF, the FDA placed a clinical hold on the IND, requiring us to submit, prior to initiating the trial, additional chemistry, manufacturing and controls information relating to materials and processes used during the manufacture of the product candidate. The FDA lifted the clinical hold in April 2018.

Conducting preclinical testing is a lengthy, time-consuming and expensive process. The length of time may vary substantially according to the type, complexity, novelty and intended use of the product candidate, and often can be several years or more per product candidate. Delays associated with product candidates for which we are conducting preclinical testing and studies ourselves may cause us to incur additional operating expenses. Moreover, we may be affected by delays associated with the preclinical testing and studies of certain product candidates conducted by our potential partners over which we have no control. The commencement and rate of completion of preclinical studies and clinical trials for a product candidate may be delayed by many factors, including, for example:

- inability to generate sufficient preclinical or other *in vivo* or *in vitro* data to support the initiation of clinical trials; and
- delays in reaching a consensus with regulatory agencies on study design.

Moreover, even if we do initiate clinical trials for other product candidates, our development efforts may not be successful, and clinical trials that we conduct or that third parties conduct on our behalf may not demonstrate sufficient safety, purity and potency or efficacy necessary to obtain the requisite regulatory approvals for any of our product candidates or product candidates employing our technology. Even if we obtain positive results from preclinical studies or initial clinical trials, we may not achieve the same success in future trials.

Success in preclinical studies or early clinical trials may not be indicative of results obtained in later trials.

Results from preclinical studies are not necessarily predictive of clinical trial results, results from early clinical trials are not necessarily predictive of later clinical trial results and interim results of a clinical trial are not necessarily indicative of final results. Our product candidates may fail to show the desired safety and efficacy in clinical development despite positive results in preclinical studies or successful advancement through initial clinical trials.

There can be no assurance that the success we achieved in preclinical studies of MRT5005 or MRT5201 or may achieve in preclinical studies of other product candidates will result in success in clinical trials of these product candidates. In addition, we cannot assure you that we will be able to achieve the same or similar success in our preclinical studies and clinical trials of our other product candidates.

Our preclinical studies in animal models have been conducted using human mRNA, which differs from animal mRNA, making it difficult for us to use animal models to assess whether our product candidates are safe or effective in humans. In particular, the preclinical studies we have conducted in rats and non-human primates are not indicative of clinical trial outcomes in CF, as success of treatment of CF in animals does not predict success in humans.

We have not completed any clinical trials evaluating any of our product candidates or proposed delivery modes, including the use of lipid-based nanoparticles, or LNPs, that are customized for delivery to specific tissues.

There is a high failure rate for drugs and biologic products proceeding through preclinical studies and clinical trials. Any product candidates we develop may fail to show the desired safety and efficacy in later stages of clinical development despite having successfully advanced through initial clinical trials. Many companies in the pharmaceutical and biotechnology industries have suffered significant setbacks in late-stage clinical trials even after achieving promising results in preclinical studies and earlier-stage clinical trials. Data obtained from preclinical and clinical activities are subject to varying interpretations, which may delay, limit or prevent regulatory approval. In addition, we may experience regulatory delays or rejections as a result of many factors, including changes in regulatory policy during the period of our product candidate development. Any such delays could materially and adversely affect our business, financial condition, results of operations and prospects.

We may find it difficult to enroll and dose patients in our clinical trials, which could delay or prevent us from proceeding with clinical trials of our product candidates.

Identifying, qualifying and enrolling patients to participate in clinical trials of our product candidates is critical to our success, and we may not be able to identify, recruit, enroll and dose a sufficient number of patients, or those with required or desired characteristics, to complete our clinical trials in a timely manner. The timing of our clinical trials depends on our ability to recruit patients to participate as well as to subsequently dose these patients and complete required follow-up periods. In particular, because our clinical trial of MRT5005 and our planned clinical trial of MRT5201 are focused on indications with relatively small patient populations, our ability to enroll eligible patients may be limited or may result in slower enrollment than we anticipate. Many CF clinical trial sites place importance on the review, ranking and sanctioning of CF patient advocacy groups. If CF patient advocacy groups do not timely sanction or highly rate our clinical trials, or prioritize trials of other sponsors over our trials, we may not be able to enroll sufficient patients to conduct our trials at their member sites, or it may take longer to conduct these trials.

In addition, we may experience enrollment delays related to increased or unforeseen regulatory, legal and logistical requirements at certain clinical trial sites. These delays could be caused by regulatory reviews by regulatory authorities and contractual discussions with individual clinical trial sites. Any delays in enrolling and/or dosing patients in our planned clinical trials could result in increased costs, delays in advancing our product candidates, delays in testing the effectiveness of our product candidates or termination of the clinical trials altogether.

Patient enrollment may be affected if our competitors have ongoing clinical trials for product candidates for the same indications as our product candidates, and patients who would otherwise be eligible for our clinical trials instead enroll in our competitors' clinical trials. Patient enrollment may also be affected by other factors, including:

- coordination between us, CROs and any future collaborators in our efforts to enroll and administer the clinical trial;

- size of the patient population and process for identifying patients;
- design of the trial protocol;
- eligibility and exclusion criteria;
- perceived risks and benefits of the product candidate under study;
- availability of competing commercially available therapies and other competing product candidates' clinical trials;
- time of year in which the trial is initiated or conducted;
- variations in the seasonal incidence of the target indication;
- severity of the disease under investigation;
- ability to obtain and maintain subject consent;
- ability to enroll and treat patients in a timely manner;
- risk that enrolled subjects will drop out before completion of the trial;
- proximity and availability of clinical trial sites for prospective patients;
- patient referral practices of physicians; and
- ability to monitor subjects adequately during and after treatment.

Our inability to enroll a sufficient number of patients for clinical trials would result in significant delays and could require us to abandon one or more clinical trials altogether. Enrollment delays in these clinical trials may result in increased development costs for our product candidates, which could cause the value of our company to decline and limit our ability to obtain additional financing.

We may not be successful in our efforts to identify or discover additional product candidates and may fail to capitalize on programs or product candidates for which there is a greater likelihood of commercial success.

Our success depends upon our ability to identify, develop and commercialize product candidates based on our MRT platform. If we do not successfully develop and eventually commercialize products, we not be able to generate product revenue, resulting in significant harm to our financial position and adverse effects to our share price. Research programs to identify new product candidates require substantial technical, financial and human resources. Although our product candidates are currently in preclinical or clinical development, we may fail to identify other potential product candidates for clinical development.

Additionally, because we have limited financial and managerial resources, we may forego or delay pursuit of opportunities for certain programs or product candidates or for indications that later prove to have greater commercial potential. For example, we currently intend to focus our capital resources primarily on the clinical development of MRT5005 and MRT5201. However, the development of MRT5005 and MRT5201 may ultimately prove to be unsuccessful or less successful than another product candidate in our pipeline that we might have chosen to pursue on a more aggressive basis with our capital resources. Our estimates regarding the potential market for our product candidates could be inaccurate, and our spending on current and future research and development programs may not yield any commercially viable products. If we do not accurately evaluate the commercial potential for a particular product candidate, we may relinquish valuable rights to that product candidate through strategic collaboration, licensing or other arrangements in cases in which it would have been more advantageous for us to retain sole development and commercialization rights. Alternatively, we may allocate internal resources to a product candidate in a therapeutic area in which it would have been more advantageous to enter into a collaborative arrangement.

If any of these events occur, we may be forced to abandon or delay our development efforts with respect to a particular product candidate, or we may fail to develop a potentially successful product candidate, which could have a material adverse effect on our business, financial condition, results of operations and prospects.

We may fail to demonstrate safety and efficacy of our product candidates to the satisfaction of applicable regulatory authorities.

If the results of any of our clinical trials are inconclusive or if there are safety concerns or serious adverse events associated with our product candidates, we may:

- be delayed in obtaining marketing approval for our product candidates, if at all;
- obtain approval for indications or patient populations that are not as broad as intended or desired;

- obtain approval with labeling that includes significant use or distribution restrictions or safety warnings;
- be subject to changes in the way the product is administered;
- be required to perform additional clinical trials to support approval or be subject to additional post-marketing testing requirements;
- have regulatory authorities withdraw, or suspend, their approval of the product or impose restrictions on its distribution in the form of a modified risk evaluation and mitigation strategy, or REMS;
- be subject to the addition of labeling statements, such as contraindications or warnings, including a black box warning;
- be sued; or
- experience damage to our reputation.

If serious adverse or undesirable side effects are identified during the development of our product candidates or proposed delivery modes, we may abandon or limit our development of such product candidates.

If our product candidates or proposed delivery modes are associated with undesirable side effects or have unexpected characteristics, we may need to abandon their development or limit development to certain uses or subpopulations in which the undesirable side effects or other characteristics are less prevalent, less severe or more acceptable from a risk-benefit perspective. Many compounds that initially showed promise in clinical or earlier stage testing have later been found to cause side effects or raise other safety issues that delayed or prevented further development of the compound. Further, given the relatively small patient populations for which we are developing our product candidates, we expect to have to evaluate long-term exposure to establish the safety and tolerability of our product candidates in a chronic dose setting. The adverse effects from long-term exposure, as well as exposure in general, to our product candidates are unknown because they are a new class of therapeutics that have never been evaluated in a clinical trial. The risk of adverse or undesirable side effects therefore remains a significant concern, and we cannot assure you that these or other risks will not occur in any of our current or future clinical trials of MRT5005, MRT5201 or other product candidates that we may develop.

If we elect or are forced to suspend or terminate any clinical trial of our product candidates, the commercial prospects of such product candidate will be harmed, and our ability to generate product revenue from such product candidate will be delayed or eliminated. Any of these occurrences could materially harm our business, financial condition, results of operations and prospects.

Because we are developing product candidates for the treatment of diseases in which there is little clinical experience using new technologies, there is increased risk that the FDA, the EMA or other regulatory authorities may not consider the endpoints of our clinical trials to provide clinically meaningful results and that these results may be difficult to analyze.

During the regulatory review process, we will need to identify success criteria and endpoints such that the FDA, the EMA or other regulatory authorities will be able to determine the clinical efficacy and safety profile of any product candidates we may develop. Because our initial focus is to identify and develop product candidates to treat diseases in which there is little clinical experience using new technologies, there is heightened risk that the FDA, the EMA or other regulatory authorities may not consider the clinical trial endpoints that we propose to provide clinically meaningful results. In addition, the resulting clinical data and results may be difficult to analyze. Even if the FDA determines that our success criteria is sufficiently validated and clinically meaningful, we may not achieve the pre-specified endpoints to a degree of statistical significance.

This may be a particularly significant risk for many of the genetically defined diseases for which we plan to develop product candidates because many of these diseases have small patient populations, and designing and executing a rigorous clinical trial with appropriate statistical power is more difficult than with diseases that have larger patient populations. Further, even if we do achieve the pre-specified criteria, the results may be unpredictable or inconsistent with the results of the non-primary endpoints or other relevant data. The FDA also weighs the benefits of a product against its risks, and the FDA may view the efficacy results in the context of safety as not being supportive of regulatory approval. The EMA and other regulatory authorities may make similar comments with respect to these endpoints and data. Any product candidate we may develop will be based on a novel technology that makes it difficult to predict the time and cost of development and of subsequently obtaining regulatory approval.

We may conduct clinical trials at sites outside the United States. The FDA may not accept data from trials conducted in such locations, and the conduct of trials outside the United States could subject us to additional delays and expense.

We may conduct one or more of our clinical trials with one or more trial sites that are located outside the United States. Although the FDA may accept data from clinical trials conducted outside the United States, acceptance of these data is subject to certain conditions imposed by the FDA. For example, the clinical trial must be well designed and conducted and performed by

qualified investigators in accordance with GCP. The FDA must be able to validate the data from the trial through an onsite inspection, if necessary. The trial population must also have a similar profile to the U.S. population, and the data must be applicable to the U.S. population and U.S. medical practice in ways that the FDA deems clinically meaningful, except to the extent the disease being studied does not typically occur in the United States. In addition, while these clinical trials are subject to the applicable local laws, whether the FDA accepts the data will depend upon its determination that the trials also complied with all applicable U.S. laws and regulations. There can be no assurance that the FDA will accept data from trials conducted outside of the United States. If the FDA does not accept the data from any trial that we conduct outside the United States, it would likely result in the need for additional trials, which would be costly and time-consuming and delay or permanently halt our development of MRT5005, MRT5201 or any future product candidates.

In addition, conducting clinical trials outside the United States could have a significant adverse impact on us. Risks inherent in conducting international clinical trials include:

- clinical practice patterns and standards of care that vary widely among countries;
- non-U.S. regulatory authority requirements that could restrict or limit our ability to conduct our clinical trials;
- administrative burdens of conducting clinical trials under multiple non-U.S. regulatory authority schema;
- foreign exchange fluctuations; and
- diminished protection of intellectual property in some countries.

The manufacture of mRNA-based therapeutics is complex and manufacturers often encounter difficulties in production. If we or any of our third-party manufacturers encounter difficulties, our ability to provide product candidates for clinical trials or products, if approved, to patients could be delayed or halted.

The manufacture of mRNA-based therapeutics is complex and requires significant expertise and capital investment, including the development of advanced manufacturing techniques and process controls. We and our third-party manufacturers must comply with current Good Manufacturing Practices, or cGMP, regulations and guidelines for the manufacturing of our product candidates used in preclinical studies and clinical trials and, if approved, marketed products. Manufacturers of biotechnology products often encounter difficulties in production, particularly in scaling up and validating initial production. Furthermore, if microbial, viral or other contaminations are discovered in our product candidates or in the manufacturing facilities where our product candidates are made, such manufacturing facilities may be closed for an extended period of time to investigate and remedy the contamination. Shortages of raw materials may also extend the period of time required to develop our product candidates.

We cannot assure you that any disruptions or other issues relating to the manufacture of any of our product candidates will not occur in the future. Any delay or interruption in the supply of clinical trial supplies could delay the completion of planned clinical trials, increase the costs associated with maintaining clinical trial programs and, depending upon the period of delay, require us to commence new clinical trials at additional expense or terminate clinical trials completely. Any adverse developments affecting clinical or commercial manufacturing of our product candidates or products may result in shipment delays, inventory shortages, lot failures, product withdrawals or recalls or other interruptions in the supply of our product candidates or products. We may also have to take inventory write-offs and incur other charges and expenses for product candidates or products that fail to meet specifications, undertake costly remediation efforts or seek more costly manufacturing alternatives. Accordingly, failures or difficulties faced at any level of our supply chain could delay or impede the development and commercialization of any of our product candidates or products and could have an adverse effect on our business, prospects, financial condition and results of operations.

If the market opportunities for our product candidates are smaller than we believe they are, even assuming approval of a product candidate, our business may suffer.

Our product candidates are based on novel therapeutic approaches. As such, physicians, hospitals, third-party payors and patients may not accept our product candidates as treatment options, even if approved. While we believe there are commercial opportunities for our product candidates, we cannot be sure that is the case, particularly given the novelty of mRNA-based therapeutics.

Our projections of both the number of people affected by disease within our target indications, as well as the subset of these people who could 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, patient foundations and market research, and may prove to be incorrect. Further, new studies may change the estimated incidence or prevalence of these diseases. The number of patients may turn out to be lower than expected. Likewise, the potentially addressable patient population for each of our product candidates may be limited or may not be amenable to treatment with our product candidates, and new patients may become increasingly difficult to identify or reach, which would adversely affect our results of operations and our business.

We face substantial competition, which may result in others discovering, developing or commercializing products before or more successfully than we do.

The biotechnology and pharmaceutical industries are characterized by rapidly advancing technologies, intense competition and a strong emphasis on proprietary products. We face and will continue to face competition from third parties that use mRNA, gene editing or gene therapy development platforms and from companies focused on more traditional therapeutic modalities, such as small molecules. The competition is likely to come from multiple sources, including large and specialty pharmaceutical and biotechnology companies, academic research institutions, government agencies and public and private research institutions.

Our competitors also include companies that are or will be developing other mRNA technology methods as well as small molecules, biologics and nucleic acid-based therapies for the same indications that we are targeting with our mRNA-based therapeutics.

Many of our potential competitors, alone or with their strategic partners, have substantially greater financial, technical and other resources, such as larger research and development, clinical, marketing and manufacturing organizations. Mergers and acquisitions in the biotechnology and pharmaceutical industries may result in even greater concentration of resources among a smaller number of competitors. Our commercial opportunity could be reduced or eliminated if competitors develop and commercialize products that are safer, more effective, have fewer or less severe side effects, are more convenient or are less expensive than any products that we may develop. Our competitors also may obtain FDA or other regulatory approval for their products faster or earlier than we may obtain approval for ours, which could result in our competitors establishing a strong market position before we are able to enter the market. Additionally, technologies developed by our competitors may render our product candidates uneconomical or obsolete, and we may not be successful in marketing our product candidates against competitors' products. In addition, the availability of our competitors' products could limit the demand and the prices we are able to charge for any products that we may develop and commercialize.

If approved for the treatment of CF, MRT5005 would compete with Kalydeco (ivacaftor), Orkambi and Symdeko, each of which is marketed by Vertex Pharmaceuticals Incorporated, or Vertex. Kalydeco (ivacaftor) is a cystic fibrosis transmembrane conductance regulator, or CFTR, potentiator that is approved for the treatment of patients with CF who have the G551D mutation or other specified mutations in their CFTR gene. Orkambi is a combination of lumacaftor, a CFTR corrector, and Kalydeco and is approved for the treatment of patients with CF who are homozygous for the F508del mutation in their CFTR gene. Symdeko is approved for patients with CF who are homozygous for the F508del mutation or have at least one mutation in their CFTR gene that is responsive to tezacaftor/ivacaftor based on *in vitro* data and *or/clinical* data. Vertex also has several CFTR corrector compounds in clinical development, including VX-440, VX-152, VX-371, VX-659 and VX-445, each of which is in Phase 2 or Phase 3 clinical trials in combination with other drugs and product candidates. Vertex announced that it initiated Phase 3 clinical trials of VX-659, with data expected in 2018, and VX-445, with data expected in the first quarter of 2019, as part of a combination therapy.

We are aware of several companies with product candidates for the treatment of CF in Phase 2 clinical development in addition to Vertex, including Copernicus Therapeutics Inc., Flatley Discovery Lab, LLC, AbbVie Inc. (pursuant to an agreement restructuring with Galapagos NV), Grifols S.A., NovaBiotics Ltd, Novartis AG, Novotersis LLC, Parion Sciences, Inc., Proteostasis Therapeutics, Inc., Protalix BioTherapeutics, Inc., Sanofi S.A., Spyryx Biosciences, Inc. and Verona Pharma plc. We are aware of several companies with product candidates for the treatment of CF in Phase 1 clinical development, including AbbVie Inc., Alpine Immune Sciences Inc., AstraZeneca plc, Eloxx Pharmaceuticals Ltd, Flatley Discovery Lab, LLC, Paranta Biosciences Ltd., ProQR Therapeutics N.V. and Proteostasis Therapeutics, Inc. Corbus Pharmaceuticals Holdings, Inc. completed a Phase 2 clinical trial of lenabasum for the treatment of CF and initiated a Phase 2b clinical trial in the first quarter of 2018.

Other companies developing products that modulate or affect CFTR function for the treatment of CF also include: Editas Medicine Inc., CRISPR Therapeutics AG, Ethris GmbH, Modema Therapeutics Inc. and Arcturus Therapeutics Ltd.

There are currently no approved therapies that address the underlying cause of OTC deficiency. There are several ammonia scavengers that treat OTC deficiency, including Buphenyl and Ravicti, each marketed by Horizon Pharma plc, and Ammonul, marketed by Swedish Orphan Biovitrum AB and Bausch Health Companies. We are aware of several product candidates in clinical development for the treatment of OTC deficiency that may compete with MRT5201. DTX301 is an adeno-associated virus, or AAV, OTC gene stimulator in Phase 1/2 clinical development by Ultragenyx Pharmaceutical Inc. HepaStem/Heparesc is a liver progenitor cell-based therapy in Phase 2 clinical development by Promethera Biosciences S.A. Lunar-OTC is an OTC gene stimulator in preclinical development by Arcturus Therapeutics Ltd. in collaboration with CureVac. SEL-313 is an AAV-based gene therapy in preclinical development by Selecta Biosciences, Inc. in collaboration with Genethon S.A.

Other companies developing products that modulate or affect OTC function for the treatment of OTC deficiency include Swedish Orphan Biovitrum AB, Roivant Sciences Ltd., Ethris GmbH and Arcturus Therapeutics Ltd.

Risks Related to Dependence on Third Parties

We expect to depend on collaborations with third parties for the research, development, manufacture and commercialization of programs or product candidates. If these collaborations are not successful, our business could be adversely affected.

As part of our strategy, we intend to seek to enter into collaborations with third parties for one or more of our programs or product candidates. For example, in June 2018, we entered into a collaboration and license agreement with Sanofi to develop mRNA vaccines for up to five infectious disease pathogens. Our likely collaborators for any other collaboration arrangements include large and mid-size pharmaceutical companies and biotechnology companies. If we enter into any such arrangements with any third parties, we will likely have limited control over the amount and timing of resources that any future collaborators dedicate to the development or commercialization of our product candidates. Our ability to generate revenue from these arrangements will depend on our collaborators' abilities to successfully perform the functions assigned to them.

Any collaborations we enter into, including our collaboration with Sanofi, may pose several risks, including the following:

- Collaborators may have significant discretion in determining the efforts and resources that they will apply to these collaborations.
- Collaborators may not perform their obligations as expected.
- The clinical trials conducted as part of these collaborations may not be successful.
- Collaborators may not pursue development and/or commercialization of any product candidates that achieve regulatory approval or may elect not to continue or renew development or commercialization programs based on clinical trial results, changes in the collaborators' strategic focus or available funding or external factors, such as an acquisition, that divert resources or create competing priorities.
- Collaborators may delay clinical trials, provide insufficient funding for clinical trials, stop a clinical trial or abandon a product candidate, repeat or conduct new clinical trials or require a new formulation of a product candidate for clinical testing.
- We may not have access to, or may be restricted from disclosing, certain information regarding product candidates being developed or commercialized under a collaboration and, consequently, may have limited ability to inform our stockholders about the status of such product candidates.
- Collaborators could independently develop, or develop with third parties, products that compete directly or indirectly with our product candidates if the collaborators believe that competitive products are more likely to be successfully developed or can be commercialized under terms that are more economically attractive than ours.
- Product candidates developed in collaboration with us may be viewed by any collaborators as competitive with their own product candidates or products, which may cause collaborators to cease to devote resources to the commercialization of our product candidates.
- A collaborator with marketing and distribution rights to one or more of our product candidates that achieve regulatory approval may not commit sufficient resources to the marketing and distribution of any such product candidate.
- Disagreements with collaborators, including disagreements over proprietary rights, contract interpretation or the preferred course of development of any programs or product candidates, may cause delays or termination of the research, development, manufacture or commercialization of such programs or product candidates, may lead to additional responsibilities for us with respect to such programs or product candidates or may result in litigation or arbitration, any of which would be time-consuming and expensive. Moreover, in certain circumstances, there could be a misalignment between the contractual obligations given to us by our collaborators and any upstream contractual obligations we may owe to our licensors or other third parties.
- Collaborators may not properly maintain or defend our intellectual property rights or may use our proprietary information in such a way as to invite litigation that could jeopardize or invalidate our intellectual property or proprietary information or expose us to potential litigation. For example, Sanofi has the first right to enforce or defend certain of our intellectual property rights under our collaboration with respect to products in Licensed Fields, and although we may have the right to assume the enforcement and defense of such intellectual property rights if Sanofi does not, our ability to do so may be compromised by Sanofi's actions.
- Disputes may arise with respect to the ownership of intellectual property developed pursuant to our collaborations.
- Collaborators may infringe the intellectual property rights of third parties, which may expose us to litigation and potential liability.

- Collaborations may be terminated for the convenience of the collaborator and, if terminated, we could be required to raise additional capital to pursue further development or commercialization of the applicable product candidates. For example, Sanofi may terminate its collaboration with us for convenience after a specified notice period.

If our collaborations do not result in the successful development and commercialization of products, or if one of any future collaborators terminates its agreement with us, we may not receive any future research funding or milestone or royalty payments under the collaboration. If we do not receive the funding we expect under these agreements, our development of product candidates could be delayed and we may need additional resources to develop our product candidates.

In addition, if any collaborator terminates its agreement with us, we may find it more difficult to attract new collaborators and our reputation among the business and financial communities could be adversely affected. All of the risks relating to product development, regulatory approval and commercialization described in this Quarterly Report on Form 10-Q also apply to the activities of our collaborators.

If we are not able to establish collaborations on commercially reasonable terms, we may have to alter our development and commercialization plans.

We face significant competition in attracting appropriate collaborators to advance the development of any product candidates for which we may seek a collaboration. Whether we reach a definitive agreement for a collaboration will depend, among other things, upon our assessment of the collaborator's resources and expertise, the terms and conditions of the proposed collaboration and the proposed collaborator's evaluation of a number of factors. Those factors may include the design or results of clinical trials, the likelihood of approval by the FDA, EMA or other regulatory authorities, the potential market for the subject product candidate, the costs and complexities of manufacturing and delivering such product candidate to patients, the potential of competing products, the existence of uncertainty with respect to our ownership of technology, which can exist if there is a challenge to such ownership without regard to the merits of the challenge, the terms of any existing collaboration agreements, and industry and market conditions generally. The collaborator may also have the opportunity to collaborate on other product candidates or technologies for similar indications and will have to evaluate whether such a collaboration could be more attractive than one with us.

Collaborations are complex and time-consuming to negotiate, document and execute. In addition, consolidation among large pharmaceutical companies has reduced the number of potential future collaborators.

Under the Shire Agreement, prior to the first dosing of a patient with a CFTR MRT Product in a Phase 3 clinical trial, Shire has a 90-day right of first negotiation before we may grant rights or sell assets relating to our CFTR MRT Products to a third party. Shire may exercise the right of first negotiation for a period of 30 days following Shire's receipt of written notice from us notifying Shire of the offer from a third party to acquire, license or commercialize grant rights or sell assets relating to our CF program.

We may not be able to negotiate collaborations on a timely basis, on acceptable terms or at all. If we are unable to do so, we may have to curtail the development of the product candidate for which we are seeking to collaborate, reduce or delay its development program or one or more of our other development programs, delay its potential commercialization or reduce the scope of any sales or marketing activities, or increase our expenditures and undertake development or commercialization activities at our own expense. If we elect to fund development or commercialization activities on our own, we may need to obtain additional capital, which may not be available to us on acceptable terms or at all. If we do not have sufficient funds, we may not be able to further develop our product candidates or bring them to market and generate product revenue, which could have an adverse effect on our business, prospects, financial condition and results of operations.

We expect to rely on third parties to conduct our clinical trials and some aspects of our research and preclinical studies, and those third parties may not perform satisfactorily, including failing to meet deadlines for the completion of such trials, research or testing.

We expect to rely on third parties, such as CROs, clinical data management organizations, medical institutions and clinical investigators, to conduct our clinical trials. In addition, we currently rely and expect to continue to rely on third parties to conduct some aspects of our research and preclinical studies. Any of these third parties may terminate their engagements with us, some in the event of an uncured material breach and some at any time for convenience. If any of our relationships with these third parties terminate, we may not be able to enter into alternative arrangements on commercially reasonable terms, if at all. Switching or including additional third parties involves increased cost and requires management's time and focus. In addition, there is a natural transition period when a new third party commences work. As a result, delays may occur in our product development activities. Although we seek to carefully manage our relationships with our third parties, we could encounter similar challenges or delays in the future and these challenges or delays could have a material adverse impact on our business, financial condition and prospects.

Our reliance on third parties for research and development activities will reduce our control over these activities but will not relieve us of our responsibilities. For example, we remain responsible for ensuring that each of our studies is conducted in accordance with the applicable protocol, legal and regulatory requirements and scientific standards. We and these third parties are required to comply with GCP, which are regulations and guidelines enforced by the FDA, the Competent Authorities of the Member States of the European Economic Area and comparable regulatory authorities, for all of our products 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 GCPs, the clinical data generated in our clinical trials may be deemed unreliable and the FDA, the EMA or comparable regulatory authorities may require us to perform additional clinical trials before approving our marketing applications. We cannot assure you that upon inspection by a given regulatory authority, such regulatory authority will determine that any of our clinical trials comply with GCP regulations. In addition, our clinical trials must be conducted with products produced under cGMP regulations. Our failure to comply with these regulations may require us to repeat clinical trials, which would delay the regulatory approval process. We also are required to register ongoing clinical trials and post the results of completed clinical trials on a U.S. government-sponsored database, clinicaltrials.gov, within certain timeframes. Similar requirements are applicable outside the United States. Failure to comply can result in fines, adverse publicity and civil and criminal sanctions.

Furthermore, third parties on whom we rely may also have relationships with other entities, some of which may be our competitors. In addition, these third parties are not 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 clinical, non-clinical and preclinical programs. If these third parties do not successfully satisfy their contractual duties or obligations or meet expected deadlines, if they need to be replaced or if the quality or accuracy of the clinical data they obtain is compromised due to the failure to adhere to our clinical protocols, regulatory requirements or for other reasons, our preclinical studies or clinical trials may be extended, delayed or terminated, and we may not be able to obtain, or may be delayed in obtaining, marketing approvals for our product candidates and will not be able to, or may be delayed in our efforts to, successfully commercialize our products. As a result, our results of operations and the commercial prospects for our products would be harmed, our costs could increase and our ability to generate revenue could be impaired.

Our reliance on third parties to manufacture our product candidates and any future products increases the risk that we will not have sufficient quantities of our product candidates or products or such quantities at an acceptable cost, which could delay, prevent or impair our development or commercialization efforts.

We do not own or operate manufacturing facilities for the production of clinical or commercial supplies of the product candidates that we are developing or evaluating in our research program. We have limited personnel with experience in drug manufacturing and lack the resources and capabilities to manufacture any of our product candidates on a clinical or commercial scale. We currently rely on third parties for supply of our product candidates, and we outsource to third parties all manufacturing of our product candidates in preparation for our clinical trials.

In order to conduct clinical trials of our product candidates, we will need to have them manufactured in potentially large quantities. Our third-party manufacturers may be unable to meet this increased demand in a timely or cost-effective manner, or at all. In addition, quality issues may arise during scale-up activities and at any other time. For example, ongoing data on the stability of our products may shorten the expiry of our products and lead to clinical trial material supply shortages, and potentially clinical trial delays. If these third-party manufacturers are unable to successfully scale up the manufacture of our product candidates in sufficient quality and quantity, the development, testing and clinical trials of that product candidate may be delayed or infeasible, and regulatory approval or commercial launch of that product candidate may be delayed or not obtained, which could significantly harm our business.

Our use of new third-party manufacturers increases the risk of delays in production or insufficient supplies of our product candidates as we transfer our manufacturing technology to these manufacturers and as they gain experience manufacturing our product candidates.

Even after a third-party manufacturer has gained significant experience in manufacturing our product candidates or even if we believe we have succeeded in optimizing the manufacturing process, there can be no assurance that such manufacturer will produce sufficient quantities of our product candidates in a timely manner or continuously over time, or at all.

We do not currently have any agreements with third-party manufacturers for the long-term commercial supply of any of our product candidates. In the future, we may be unable to enter into such agreements with third-party manufacturers for commercial supplies of our product candidates, or may be unable to do so on acceptable terms. Even if we are able to establish and maintain arrangements with third-party manufacturers, reliance on third-party manufacturers entails risks, including:

- reliance on the third party for regulatory compliance and quality assurance;
- the possible breach of the manufacturing agreement by the third party;
- the possible misappropriation of our proprietary information, including our trade secrets and know-how; and
- the possible termination or nonrenewal of the agreement by the third party at a time that is costly or inconvenient for us.

Third-party manufacturers may not be able to comply with cGMP requirements or similar regulatory requirements outside the United States. Our failure, or the failure of our third-party manufacturers, to comply with applicable requirements could result in sanctions being imposed on us, including fines, injunctions, civil penalties, delays, suspension or withdrawal of approvals, license revocation, seizures or recalls of product candidates or products, operating restrictions and/or criminal prosecutions, any of which could significantly and adversely affect supplies of our product candidates.

Our product candidates and any products that we may develop may compete with other product candidates and products for access to manufacturing facilities. There are a limited number of manufacturers that operate under cGMP requirements particularly for the development of mRNA-based therapeutics, and that might be capable of manufacturing for us.

If the third parties that we engage to supply any materials or manufacture product for our preclinical tests and clinical trials should cease to do so for any reason, we likely would experience delays in advancing these tests and trials while we identify and qualify replacement suppliers or manufacturers, and we may be unable to obtain replacement supplies on terms that are favorable to us. For example, we rely on one third-party supplier of the handheld nebulizer that patients in our clinical trials will use to administer MRT5005. The failure of our supplier to provide sufficient quantities, acceptable quality and timely delivery of the nebulizer at an acceptable price, or an interruption in the delivery of goods from such supplier, could delay or otherwise adversely affect our clinical trials of MRT5005, and harm our business and prospects. The use of an alternative manufacturer of the nebulizer could involve significant delays and other costs and regulatory challenges, and may not be available to us on reasonable terms, if at all. In addition, if we are not able to obtain adequate supplies of our product candidates or the substances used to manufacture them, it will be more difficult for us to develop our product candidates and compete effectively.

Our current and anticipated future dependence upon others for the manufacture of our product candidates may adversely affect our future profit margins and our ability to develop product candidates and commercialize any products that receive marketing approval on a timely and competitive basis.

Risks Related to the Commercialization of our Product Candidates

If we are unable to establish sales, medical affairs and marketing capabilities or enter into agreements with third parties to market and sell our product candidates, we may be unable to generate any product revenue.

We do not currently have a sales and marketing organization and have never commercialized a product. To successfully commercialize any products that may result from our development programs, we will need to develop these capabilities, either on our own or with others. The establishment and development of our own commercial and medical science liaison teams or the engagement of a contract sales force will be expensive and time-consuming and could delay any product launch. Moreover, we cannot be certain that we will be able to successfully develop this capability. We have entered into a collaboration with Sanofi and may also seek to enter into future collaborations with other entities to utilize their established marketing and distribution capabilities, but we may be unable to enter into such agreements on favorable terms, if at all. If our collaborators do not commit sufficient resources to commercialize our products, or we are unable to develop the necessary capabilities on our own, we will be unable to generate sufficient product revenue to sustain our business. We compete with many well-funded and profitable pharmaceutical and biotechnology companies that currently have extensive and experienced medical affairs, marketing and sales operations to recruit, hire, train and retain marketing and sales personnel. We also face competition in our search for third parties to assist us with the sales and marketing efforts of our product candidates. Without an internal team or the support of a third party to perform marketing, sales and medical affairs functions, we may be unable to compete successfully against these more established companies.

Our efforts to educate the medical community and third-party payors about the benefits of our product candidates may require significant resources and may never be successful. If any of our product candidates are approved but fail to achieve market acceptance among physicians, patients, hospitals or third-party payors, we will not be able to generate significant revenue from such product, which could have a material adverse effect on our business, financial condition, results of operations and prospects.

The hospital formulary approval and insurance coverage and reimbursement status of newly approved products is uncertain. Failure to obtain or maintain adequate hospital formulary approval and/or insurance coverage and reimbursement for our products, if approved, could limit our ability to market those products and decrease our ability to generate product revenue.

We expect that hospital formulary approval and insurance coverage and reimbursement by government and other third-party payors of our products, if approved, will be essential for most patients to be able to access these treatments. Accordingly, sales of our product candidates, if approved, will depend substantially on the extent to which the costs of our product candidates will be paid by hospitals or will be reimbursed by government authorities, private health coverage insurers and other third-party payors. Hospital formulary approval and insurance coverage and reimbursement by other third-party payors may depend upon several factors, including the third-party payor's determination that use of a product is:

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

Obtaining hospital formulary approval and insurance coverage and reimbursement for a product from third-party payors is a time-consuming and costly process that will require us to provide to the hospitals and payors supporting scientific, clinical and cost-effectiveness data. We may not be able to provide data sufficient to gain acceptance with respect to hospital formulary approval and insurance coverage and reimbursement. If hospital formulary approval, insurance coverage and reimbursement are not available, or are available only at limited levels, we may not be able to successfully commercialize our product candidates.

There is significant uncertainty related to hospital formulary approval and insurance coverage and reimbursement of newly approved products. In the United States, third-party payors, including government payors such as the Medicare and Medicaid programs, play an important role in determining the extent to which new drugs and biologics will be covered and reimbursed. It is difficult to predict what third-party payors will decide with respect to the insurance coverage and reimbursement for our product candidates.

Outside the United States, international operations generally are subject to extensive government price controls and other market regulations, and increasing emphasis on cost-containment initiatives in the European Union, Canada and other countries may put pricing pressure on us. In many countries, the prices of medical products are subject to varying price control mechanisms as part of national health systems. In general, the prices of medicines under such systems are substantially lower than in the United States. Other countries may use different methods to keep the cost of medical products artificially low. Foreign price controls or other changes in pricing regulation could restrict the amount that we are able to charge for our product candidates. Accordingly, in markets outside the United States, the reimbursement for our products may be reduced compared with the United States and may be insufficient to generate commercially reasonable product revenue.

Moreover, hospitals and government and other third-party payors in the United States and abroad have increasingly taken measures to cap or reduce health care costs. For example, governmental and other third-party payors may attempt to limit both coverage and the level of reimbursement for new products approved and, as a result, they may not cover or provide adequate payment for our product candidates. We expect to experience pricing pressures in connection with the sale of any of our product candidates due to the trend toward reducing hospital costs, managed health care, the increasing influence of health maintenance organizations and additional legislative changes.

The commercial success of any of our product candidates will depend upon its degree of market acceptance by physicians, patients, hospitals, third-party payors and others in the medical community.

Even with the requisite approvals from the FDA in the United States, EMA in the European Union and other regulatory authorities internationally, the commercial success of our product candidates, if approved, will significantly depend on the acceptance of physicians, hospitals and health care payors of our product candidates as medically necessary, cost-effective and safe. Any product that we commercialize may not gain acceptance by physicians, hospitals, health care payors and others in the medical community. If these commercialized products do not achieve an adequate level of acceptance, we may not generate significant product revenue and may not become profitable. The degree of market acceptance of our product candidates, if approved for commercial sale, will depend on several factors, including:

- the efficacy and safety of such product candidates as demonstrated in clinical trials;
- the potential and perceived advantages of our product candidates over other treatments;

- the cost-effectiveness of treatment relative to alternative treatments;
- the clinical indications for which the product candidate is approved by the FDA, the EMA or other regulatory body;
- the willingness of physicians to prescribe new therapies over the existing standard of care and future new therapies;
- the willingness of the target patient population to try new therapies;
- the prevalence and severity of any side effects;
- product labeling or product insert requirements of the FDA, EMA or other regulatory authorities, including any limitations or warnings contained in a product's approved labeling, including any black box warning;
- relative convenience and ease of administration;
- our ability to educate the medical community and third-party payors about the benefit of our product candidates;
- the strength of marketing and distribution support;
- the timing of market introduction of competitive products;
- any restrictions on the use of our products together with other medications;
- publicity concerning our products or competing products and treatments; and
- sufficient third-party payor insurance coverage and adequate reimbursement.

Even if a potential product displays a favorable efficacy and safety profile in preclinical studies and clinical trials, market acceptance of the product will not be fully known until after we begin to commercialize the product.

If we obtain approval to commercialize our product candidates outside of the United States, a variety of risks associated with international operations could materially adversely affect our business.

We expect that we will be subject to additional risks in commercializing our product candidates outside the United States, including:

- different regulatory requirements for approval of drugs and biologics in foreign countries;
- reduced protection for intellectual property rights;
- unexpected changes in tariffs, trade barriers and regulatory requirements;
- economic weakness, including inflation, or political instability foreign economies and markets;
- different pricing and reimbursement regimes;
- compliance with tax, employment, immigration and labor laws for employees living or traveling abroad;
- foreign currency fluctuations, which could result in increased operating expenses and reduced revenue, and other obligations incident to doing business in another country;
- workforce uncertainty in countries where labor unrest is more common than in the United States;
- production shortages resulting from any events affecting raw material supply or manufacturing capabilities abroad; and
- business interruptions resulting from geopolitical actions, including war and terrorism or natural disasters, including earthquakes, typhoons, floods and fires.

Risks Related to Our Business Operations

Our future success depends on our ability to retain key employees, consultants and advisors and to attract, retain and motivate qualified personnel.

We are highly dependent on members of our executive team. The loss of the services of any of them may adversely impact the achievement of our objectives. Any of our executive officers could leave our employment at any time, as all of our employees are "at-will" employees.

Recruiting and retaining qualified employees, consultants and advisors for our business, including scientific and technical personnel, is also critical to our success. Competition for skilled personnel is intense and the turnover rate can be high. We may not be able to attract and retain personnel on acceptable terms given the competition among numerous pharmaceutical and biotechnology companies and academic institutions for skilled individuals. In addition, failure to succeed in preclinical studies, clinical trials or applications for marketing approval may make it more challenging to recruit and retain qualified personnel. The inability to recruit, or loss of services of certain executives, key employees, consultants or advisors, may impede the progress of our research, development and commercialization objectives and have a material adverse effect on our business, financial condition, results of operations and prospects.

If we are unable to manage expected growth in the scale and complexity of our operations, our performance may suffer.

If we are successful in executing our business strategy, we will need to expand our managerial, operational, financial and other systems and resources to manage our operations, continue our research and development activities and, in the longer term, build a commercial infrastructure to support commercialization of any of our product candidates that are approved for sale. Future growth would impose significant added responsibilities on members of management. It is likely that our management, finance, development personnel, systems and facilities currently in place may not be adequate to support this future growth. Our need to effectively manage our operations, growth and product candidates requires that we continue to develop more robust business processes and improve our systems and procedures in each of these areas and to attract and retain sufficient numbers of talented employees. We may be unable to successfully implement these tasks on a larger scale and, accordingly, may not achieve our research, development and growth goals.

Product liability lawsuits against us could cause us to incur substantial liabilities and could limit commercialization of any product candidates that we may develop.

We face an inherent risk of product liability exposure related to the testing of our product candidates in clinical trials and may face an even greater risk if we commercialize any products that we may develop. If we cannot successfully defend ourselves against claims that our product candidates caused injuries, we could incur substantial liabilities. Regardless of merit or eventual outcome, liability claims may result in:

- decreased demand for any product candidates that we may develop;
- loss of revenue;
- substantial monetary awards to trial participants or patients;
- significant time and costs to defend the related litigation;
- withdrawal of clinical trial participants;
- the inability to commercialize any product candidates that we may develop; and
- injury to our reputation and significant negative media attention.

Our insurance coverage may not be adequate to cover all liabilities that we may incur. We anticipate that we will need to increase our insurance coverage each time we commence a clinical trial and if we successfully commercialize any product candidate. Insurance coverage is increasingly expensive. We may not be able to maintain insurance coverage at a reasonable cost or in an amount adequate to satisfy any liability that may arise.

Our internal computer systems, or those of any collaborators, contractors or consultants, may fail or suffer security breaches, which could result in a material disruption of our product development programs.

Our internal computer systems and those of any collaborators, contractors or consultants are vulnerable to damage from computer viruses, unauthorized access, natural disasters, terrorism, war and telecommunication and electrical failures. While we have not experienced any such material system failure, accident or security breach to date, if such an event were to occur and cause interruptions in our operations, it could result in a material disruption of our development programs and our business operations, whether due to a loss of our trade secrets or other proprietary information or other similar disruptions. For example, the loss of clinical trial data from completed or future 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, our competitive position could be harmed and the further development and commercialization of our product candidates could be delayed.

Our employees, principal investigators, consultants and commercial partners may engage in misconduct or other improper activities, including non-compliance with regulatory standards and requirements and insider trading laws.

We are exposed to the risk of fraud or other misconduct by our employees, principal investigators, consultants and commercial partners. Misconduct by these parties could include failures to:

- comply with FDA regulations or the regulations applicable in the European Union and other jurisdictions;
- provide accurate information to the FDA, the EMA and other regulatory authorities;
- comply with health care fraud and abuse laws and regulations in the United States and abroad;
- comply with the U.S. Foreign Corrupt Practices Act, or FCPA, or other anti-corruption laws and regulations;
- comply with U.S. federal securities laws relating to trading in our common stock;
- report financial information or data accurately; or
- disclose unauthorized activities to us.

In particular, sales, marketing and business arrangements in the health care industry are subject to extensive laws and regulations intended to prevent fraud, misconduct, kickbacks, self-dealing and other abusive practices. These laws and regulations regulate a wide range of pricing, discounting, marketing and promotional practices, as well as sales and customer incentive programs and other business arrangements. Other forms of misconduct could involve the improper use of information obtained in the course of clinical trials or interactions with the FDA, EMA or other regulatory authorities, which could result in regulatory sanctions and cause serious harm to our reputation. We have adopted a code of conduct and expect to implement other internal controls applicable to all of our employees, consultants and contractors, but it is not always possible to identify and deter third-party misconduct, and the precautions we take to detect and prevent this activity may not be effective in controlling unknown or unmanaged risks or losses or in protecting us from government investigations or other actions or lawsuits stemming from a failure to comply with these laws or regulations. If any such actions are instituted against us and we are not successful in defending ourselves or asserting our rights, we may be subject to civil, criminal and/or administrative penalties, damages, fines, disgorgement, individual imprisonment, exclusion from participation in government health care programs, contractual damages, reputational harm, administrative burdens, diminished profits and future earnings, additional reporting obligations and oversight if we become subject to a corporate integrity agreement or similar agreement to resolve allegations of non-compliance with these laws and the curtailment or restructuring of our operations, any of which could have a significant impact on our business, financial condition, results of operations and prospects.

Risks Related to Our Intellectual Property

If we are unable to obtain and maintain patent protection for our products and technology, or if the scope of the patent protection obtained is not sufficiently broad or robust, our competitors could develop and commercialize products and technology similar or identical to ours, and our ability to successfully commercialize our products and technology may be adversely affected.

Our success depends, in large part, on our ability to obtain and maintain patent protection in the United States and other countries with respect to our product candidates and technology. We and our licensors have sought, and intend to seek, to protect our proprietary position by filing patent applications in the United States and abroad related to our product candidates and technology that are important to our business.

The patent position of biotechnology and pharmaceutical companies generally is highly uncertain, involves complex legal and factual questions and 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. Our pending and future patent applications may not result in patents being issued which protect our technology or product candidates or which effectively prevent others from commercializing competitive technologies and product candidates. Since patent applications in the United States and most other countries are confidential for a period of time after filing, and some remain so until issued, we cannot be certain that we or our licensors were the first to file a patent application relating to any particular aspect of a product candidate. Furthermore, if third parties have filed such patent applications, an interference proceeding in the United States can be initiated by such third party, or by the United States Patent and Trademark Office, or USPTO, itself, to determine who was the first to invent any of the subject matter covered by the patent claims of our applications.

The patent prosecution process is expensive, time-consuming and complex, and we may not be able to file, prosecute, maintain, enforce or license all necessary or desirable patent applications at a reasonable cost or in a timely manner. It is also possible that we will fail to identify patentable aspects of our research and development output before it is too late to obtain patent protection.

Periodic maintenance fees, renewal fees, annuity fees and various other government fees on patents and/or applications will be due to be paid to the USPTO and various government patent agencies outside of the United States over the lifetime of our licensed patents and/or applications and any patent rights we own or may own in the future. We rely, in part, on our outside counsel or our licensing partners to pay these fees due to the USPTO and to non-U.S. patent agencies. The USPTO and various non-U.S. government patent agencies require compliance with several procedural, documentary, fee payment and other similar provisions during the patent application process. We employ reputable law firms and other professionals to help us comply and we are also dependent on our licensors to take the necessary action to comply with these requirements with respect to our licensed intellectual property. In many cases, an inadvertent lapse can be cured by payment of a late fee or by other means in accordance with the applicable rules. There are situations, however, in which non-compliance can result in abandonment or lapse of the patent or patent application, resulting in partial or complete loss of patent rights in the relevant jurisdiction. In such an event, potential competitors might be able to enter the market and this circumstance could have a material adverse effect on our business.

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

Even if the patent applications we license or own do issue as patents, they may not issue in a form that will provide us with any meaningful protection, prevent competitors or other third parties from competing with us or otherwise provide us with any competitive advantage. Our competitors or other third parties may be able to circumvent our patents by developing similar or alternative technologies or products in a non-infringing manner.

The issuance of a patent is not conclusive as to its inventorship, scope, validity or enforceability, and our patents may be challenged in the courts or patent offices in the United States and abroad. Such challenges may result in loss of exclusivity or in patent claims being narrowed, invalidated or held unenforceable, 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. 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. As a result, our intellectual property may not provide us with sufficient rights to exclude others from commercializing products similar or identical to ours.

Our product candidates may face competition from biosimilars approved through an abbreviated regulatory pathway.

The Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act of 2010, or collectively the ACA, includes a subtitle called the Biologics Price Competition and Innovation Act of 2009, or BPCIA, which created an abbreviated approval pathway for biological products that are biosimilar to or interchangeable with an FDA-approved reference biological product. Under the BPCIA, an application for a biosimilar product may not be submitted to the FDA until four years following the date that the reference product was first approved by the FDA. In addition, the approval of a biosimilar product may not be made effective by the FDA until 12 years from the date on which the reference product was first approved. During this 12-year period of exclusivity, another company may still market a competing version of the reference product if the FDA approves a full Biologics License Application, or BLA, for the competing product containing the sponsor's own preclinical data and data from adequate and well-controlled clinical trials to demonstrate the safety, purity and potency of the other company's product. The law is complex and is still being interpreted and implemented by the FDA. As a result, its ultimate impact, implementation, and meaning are subject to uncertainty.

We believe that any of our product candidates approved 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 our product candidates to be reference products for competing products, potentially creating the opportunity for generic competition sooner than anticipated. Other aspects of the BPCIA, some of which may impact the BPCIA exclusivity provisions, have also been the subject of recent litigation. Moreover, the extent to which a biosimilar, once approved, will be substituted for any one of our 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.

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

As is the case with other biotechnology and pharmaceutical companies, our success is heavily dependent on intellectual property, particularly patents. Obtaining and enforcing patents in the biopharmaceutical industry involves both technological and legal complexity, and obtaining and enforcing biopharmaceutical patents is costly, time consuming and inherently uncertain. The U.S.

Supreme Court has ruled on several patent cases in recent years, and these decisions have narrowed the scope of patent protection available in certain circumstances or weakened the rights of patent owners in certain situations. In addition to increasing uncertainty with regard to our and our licensors' ability to obtain patents in the future, this combination of events has created uncertainty with respect to the value of patents once obtained. Depending on future decisions by the U.S. Congress, the federal courts and the USPTO, as well as similar bodies in foreign jurisdictions, the laws and regulations governing patents could change in unpredictable ways that may weaken our and our licensors' ability to obtain new patents or to enforce existing patents and patents we and our licensors or any collaborators may obtain in the future.

Patent reform legislation enacted in the United States in 2011 could increase the uncertainties and costs surrounding the prosecution of our and our licensors' patent applications and the enforcement or defense of our or our licensors' issued patents. On September 16, 2011, the Leahy-Smith America Invents Act, or the Leahy-Smith Act, was signed into law. The Leahy-Smith Act includes a number of significant changes to U.S. patent law. These include provisions that affect the way patent applications are prosecuted, redefine prior art, may affect patent litigation and switch the U.S. patent system from a "first to invent" system to a "first inventor to file" system. The USPTO has developed new regulations and procedures to govern administration of the Leahy-Smith Act, and many of the substantive changes to patent law associated with the Leahy-Smith Act, and in particular the first inventor to file provisions, became effective on March 16, 2013. Accordingly, it is not clear what, if any, impact the Leahy-Smith Act will have on the operation of our business. However, the Leahy-Smith Act and its implementation could increase the uncertainties and costs surrounding the prosecution of our or our licensors' patent applications and the enforcement or defense of our or our licensors' issued patents, all of which could have a material adverse effect on our business and financial condition.

Our rights to develop and commercialize our product candidates are subject, in part, to the terms and conditions of licenses granted to us by others, and, if we fail to comply with our obligations under these arrangements, we could lose such intellectual property rights or owe damages to the licensor of such intellectual property.

We are a party to several intellectual property license agreements, including agreements with the Massachusetts Institute of Technology, or MIT, that are important to our business, and may need to obtain additional licenses from others to advance our research or allow commercialization of our product candidates. These and other licenses may not provide exclusive rights to use such intellectual property and technology in all relevant fields of use and in all territories in which we may wish to develop or commercialize our technology and product candidates in the future. It is possible that we may be unable to obtain additional licenses at a reasonable cost or on reasonable terms, if at all. As a result, we may not be able to prevent competitors from developing and commercializing competitive products in territories included in all of our licenses. In that event, we may be required to expend significant time and resources to redesign our product candidates or the methods for manufacturing them or to develop or license replacement technology, all of which may not be feasible on a technical or commercial basis. 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.

Our existing license agreements impose, and we expect that future license agreements will impose, various diligence, development and commercialization timelines, milestone payments, royalties and other obligations on us. If we fail to comply with our obligations under these agreements, or we are subject to a bankruptcy, the licensor may have the right to terminate the license, in which event we would not be able to market products covered by the license.

For example, our license agreement with MIT imposes specified diligence, annual payment, milestone payment, royalty and other obligations on us. If we fail to comply with our obligations under the license agreement, MIT may have the right to terminate the license agreement, in which event we might not be able to market, and may be required to transfer to MIT our rights in, any product that is covered by the MIT agreement, including MRT5201 and products that may be developed under our collaboration with Sanofi. Termination of the license agreement may also result in our having to negotiate a new or reinstated license with less favorable terms, which would have a material adverse impact on our business.

In our existing license agreements, and we expect in future agreements, patent prosecution of our licensed technology is in certain cases controlled solely by the licensor, and we are in certain cases required to reimburse the licensor for their costs of patent prosecution. If our licensors fail to obtain and maintain patent or other protection for the proprietary intellectual property we license from them, we could lose our rights to the intellectual property or our exclusivity with respect to those rights, and our competitors could market competing products covered by the intellectual property. Further, in each of our license agreements, we are responsible for bringing any actions against any third party for infringing the patents we have licensed. Certain of our license agreements also require us to meet development thresholds to maintain the license, including establishing a set timeline for developing and commercializing products and minimum yearly diligence obligations in developing and commercializing the product. Disputes may arise regarding intellectual property subject to a licensing agreement, including:

- the scope of rights granted under the license agreement and other interpretation-related issues;
- the extent to which our technology and processes infringe the intellectual property of the licensor that is not subject to the licensing agreement;

- the sublicensing of patent and other rights under any collaborative development relationships;
- our diligence obligations under the license agreement and what activities satisfy those diligence obligations;
- the inventorship or ownership of inventions and know-how resulting from the joint creation or use of intellectual property by our licensors and us and our partners; and
- the priority of invention of patented technology.

If disputes over intellectual property that we have licensed 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.

In addition, the agreements under which we currently license intellectual property or technology from third parties are complex, and certain provisions in such agreements may be susceptible to multiple interpretations. The resolution of any contract interpretation disagreement that may arise could narrow what we believe to be the scope of our rights to the relevant intellectual property or technology, or increase what we believe to be our financial or other obligations under the relevant agreement, either of which could have a material adverse effect on our business, financial condition, results of operations and prospects.

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

Competitors may infringe our patents or the patents of our licensing partners, or we may be required to defend against claims of infringement. Countering infringement or unauthorized use claims or defending against claims of infringement can be expensive and time-consuming. Even if resolved in our favor, litigation or other legal proceedings relating to intellectual property claims may cause us to incur significant expenses and could distract our technical and management personnel from their normal responsibilities. In addition, there could be public announcements of the results of hearings, motions or other interim proceedings or developments, and if securities analysts or investors perceive these results to be negative, it could have a substantial adverse effect on the price of our common stock. Such litigation or proceedings could substantially increase our operating losses and reduce the resources available for development activities or any future sales, marketing or distribution activities. We may not have sufficient financial or other resources to adequately conduct such litigation or proceedings. Some of our competitors may be able to sustain the costs of such litigation or proceedings more effectively than we can because of their greater financial resources and more mature and developed intellectual property portfolios. Uncertainties resulting from the initiation and continuation of patent litigation or other proceedings could have a material adverse effect on our ability to compete in the marketplace.

In addition, 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, particularly those relating to biotechnology products, which could make it difficult for us to stop the infringement of our patents or marketing of competing products in violation of our proprietary rights generally. Proceedings to enforce our patent rights in foreign jurisdictions could result in substantial costs and divert our efforts and attention from other aspects of our business, could put our patents at risk of being invalidated or interpreted narrowly and our patent applications at risk of not issuing and could provoke third parties to assert claims against us. We may not prevail in any lawsuits that we initiate and the damages or other remedies awarded, if any, may not be commercially meaningful. Accordingly, our efforts to enforce our intellectual property rights around the world may be inadequate to obtain a significant commercial advantage from the intellectual property that we own, develop or license.

Issued patents covering our product candidates could be found invalid or unenforceable if challenged in court. We may not be able to protect our trade secrets in court.

If we or one of our licensing partners initiates legal proceedings against a third party to enforce a patent covering one of our product candidates, the defendant could counterclaim that the patent covering our product candidate is invalid or unenforceable. In patent litigation in the United States, defendant counterclaims alleging invalidity or unenforceability are commonplace. Grounds for a validity challenge could be an alleged failure to meet any of several statutory requirements, including lack of novelty, obviousness, written description or non-enablement. In addition, patent validity challenges may, under certain circumstances, be based upon non-statutory obviousness-type double patenting, which, if successful, could result in a finding that the claims are invalid for obviousness-type double patenting or the loss of patent term, including a patent term adjustment granted by the USPTO, if a terminal disclaimer is filed to obviate a finding of obviousness-type double patenting. Grounds for an unenforceability assertion could be an allegation that someone connected with prosecution of the patent withheld information material to patentability from the USPTO, or made a misleading statement, during prosecution. Third parties also may raise similar claims before administrative bodies in the United States or abroad, even outside the context of litigation. Such mechanisms include re-examination, post grant review, *inter partes* review and equivalent proceedings in foreign jurisdictions. Such proceedings could result in the revocation or cancellation of or amendment to our patents in such a way that they no longer cover our product candidates. The outcome following legal assertions of invalidity and unenforceability is unpredictable. With respect to the validity question, for example, we cannot be certain that there is no invalidating prior art of which the patent examiner and we or our licensing partners were unaware during prosecution. If a defendant were to

prevail on a legal assertion of invalidity or unenforceability, we could lose at least part, and perhaps all, of the patent protection on one or more of our product candidates. Such a loss of patent protection could have a material adverse impact on our business.

In addition to the protection afforded by patents, we rely on trade secret protection and confidentiality agreements to protect 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 have 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.

Third parties may initiate legal proceedings alleging that we are infringing their intellectual property rights, the outcome of which would be uncertain and could have a material adverse effect on the success of our business.

Our commercial success depends upon our ability and the ability of any collaborators to develop, manufacture, market and sell our product candidates and use our proprietary technologies without infringing the proprietary rights and intellectual property of third parties. We cannot provide any assurances that third-party patents do not exist which might be enforced against our current manufacturing methods, product candidates or future methods or products, resulting in either an injunction prohibiting our manufacture or sales, or, with respect to our sales, an obligation on our part to pay royalties and/or other forms of compensation to third parties. The biotechnology and pharmaceutical industries are characterized by extensive and complex litigation regarding patents and other intellectual property rights. We may in the future become party to, or be threatened with, adversarial proceedings or litigation regarding intellectual property rights with respect to our product candidates and technology, including interference proceedings, post grant review and *inter partes* review before the USPTO. The risks of being involved in such litigation and proceedings may also increase as our product candidates approach commercialization and as we gain greater visibility as a public company. Third parties may assert infringement claims against us based on existing patents or patents that may be granted in the future, regardless of their merit. There is a risk that third parties may choose to engage in litigation with us to enforce or to otherwise assert their patent rights against us. Even if we believe such claims are without merit, a court of competent jurisdiction could hold that these third-party patents are valid, enforceable and infringed, which could materially and adversely affect our ability to commercialize any of our product candidates or technologies covered by the asserted third-party patents. In order to successfully challenge the validity of any such U.S. patent in federal court, we would need to overcome a presumption of validity. As this burden is a high one requiring us to present clear and convincing evidence as to the invalidity of any such U.S. patent claim, there is no assurance that a court of competent jurisdiction would invalidate the claims of any such U.S. patent.

If we are found to infringe a third party's valid and enforceable intellectual property rights, we could be required to obtain a license from such third party to continue developing, manufacturing and marketing our product candidates and technology. However, we may not be able to obtain any required license on commercially reasonable terms or at all. Even if we were able to obtain a license, it could be non-exclusive, thereby giving our competitors and other third parties access to the same technologies licensed to us, and it could require us to make substantial licensing and royalty payments. We could be forced, including by court order, to cease developing, manufacturing and commercializing the infringing technology or product candidates. In addition, we could be found liable for monetary damages, including treble damages and attorneys' fees, if we are found to have willfully infringed a patent or other intellectual property right. A finding of infringement could prevent us from manufacturing and commercializing our product candidates or force us to cease some of our business operations, which could materially harm our business. Claims that we have misappropriated the confidential information or trade secrets of third parties could have a similar negative impact on our business, financial condition, results of operations and prospects.

Others may claim an ownership interest in our intellectual property and our product candidates, which could expose us to litigation and have a significant adverse effect on our prospects.

While we are presently unaware of any claims or material assertions by third parties with respect to our patents or other intellectual property, we cannot guarantee that a third party will not assert a claim or an interest in any of such patents or intellectual property. For example, a third party may claim an ownership interest in one or more of our, or our licensors', patents or other proprietary or intellectual property rights. A third party could bring legal actions against us and seek monetary damages or enjoin clinical testing, manufacturing or marketing of the affected product candidate or product. If we become involved in any litigation, it could consume a substantial portion of our resources and cause a significant diversion of effort by our technical and management personnel. If any such action is successful, in addition to any potential liability for damages, we could be required to obtain a license

to continue to manufacture or market the affected product candidate or product, in which case we could be required to pay substantial royalties or grant cross-licenses to patents. We cannot, however, assure you that any such license would be available on acceptable terms, if at all. Ultimately, we could be prevented from commercializing a product, or forced to cease some aspect of our business operations as a result of claims of patent infringement or violation of other intellectual property rights. Further, the outcome of intellectual property litigation is subject to uncertainties that cannot be adequately quantified in advance, including the demeanor and credibility of witnesses and the identity of any adverse party. This is especially true in intellectual property cases, which may turn on the testimony of experts as to technical facts upon which experts may reasonably disagree. Any of the foregoing could have a material adverse effect on our business, financial condition, results of operations or prospects.

If we are unable to protect the confidentiality of our proprietary information, the value of our technology and products could be adversely affected.

Trade secrets and know-how can be difficult to protect. To maintain the confidentiality of trade secrets and proprietary information, we enter into confidentiality agreements with our employees, consultants, collaborators and others upon the commencement of their relationships with us. These agreements require that all confidential information developed by the individual or made known to the individual by us during the course of the individual's relationship with us be kept confidential and not disclosed to third parties. Our agreements with employees and our personnel policies also provide that any inventions conceived by the individual in the course of rendering services to us shall be our exclusive property. However, we may not obtain these agreements in all circumstances, and individuals with whom we have these agreements may not comply with their terms. Thus, despite such agreement, there can be no assurance that such inventions will not be assigned to third parties. In the event of unauthorized use or disclosure of our trade secrets or proprietary information, these agreements, even if obtained, may not provide meaningful protection, particularly for our trade secrets or other confidential information. To the extent that our employees, consultants or contractors use technology or know-how owned by third parties in their work for us, disputes may arise between us and those third parties as to the rights in related inventions. To the extent that an individual who is not obligated to assign rights in intellectual property to us is rightfully an inventor of intellectual property, we may need to obtain an assignment or a license to that intellectual property from that individual, or a third party or from that individual's assignee. Such assignment or license may not be available on commercially reasonable terms or at all.

Adequate remedies may not exist in the event of unauthorized use or disclosure of our proprietary information. The disclosure of our trade secrets would impair our competitive position and may materially harm our business, financial condition and results of operations. Costly and time-consuming litigation could be necessary to enforce and determine the scope of our proprietary rights, and failure to maintain trade secret protection could adversely affect our competitive business position. In addition, others may independently discover or develop our trade secrets and proprietary information, and the existence of our own trade secrets affords no protection against such independent discovery. For example, a public presentation in the scientific or popular press on the properties of our product candidates could motivate a third party, despite any perceived difficulty, to assemble a team of scientists having backgrounds similar to those of our employees to attempt to independently reverse engineer or otherwise duplicate our antibody technologies to replicate our success.

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.

Many 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, or that patents and applications we have filed to protect inventions of these employees, even those related to one or more of our product candidates, are rightfully owned by their former or current 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.

In addition, while it is our policy to require our employees and contractors who may be involved in the conception or 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, conceives or develops intellectual property that we regard as our own. The assignment of intellectual property rights may not be self-executing or the assignment agreements may be breached, and we may be forced to bring claims against third parties, or defend claims that they may bring against us, to determine the ownership of what we regard as our intellectual property.

If our trademarks and trade names are not adequately protected, then we may not be able to build name recognition in our markets of interest and our business may be adversely affected.

Any registered trademarks or trade names may be challenged, circumvented or declared generic or determined to be infringing on other marks. We may not be able to protect our rights to these trademarks and trade names, which we need to build name recognition among potential partners or customers in our markets of interest. At times, competitors may adopt trade names or trademarks similar to ours, thereby impeding our ability to build brand identity and possibly leading to market confusion. In addition, there could be potential trade name or trademark infringement claims brought by owners of other registered trademarks or trademarks that incorporate variations of our registered or unregistered trademarks or trade names. Over the long term, if we are unable to establish name recognition based on our trademarks and trade names, then we may not be able to compete effectively and our business may be adversely affected. Our efforts to enforce or protect our proprietary rights related to trademarks, trade secrets, domain names, copyrights or other intellectual property may be ineffective and could result in substantial costs and diversion of resources and could adversely impact our financial condition or results of operations.

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 but that are not covered by the claims of the patents that we own or license or may own in the future;
- we, or any partners or collaborators, might not have been the first to make the inventions covered by the issued patent or pending patent application that we license or may own in the future;
- we, or any partners 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 owned or licensed intellectual property rights;
- it is possible that our pending licensed patent applications or those that we may own in the future 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;
- our competitors 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 have an adverse effect on our business; and
- we may choose not to file a patent for certain trade secrets or know-how, and a third party may subsequently file a patent covering such intellectual property.

Should any of these events occur, they could significantly harm our business, financial condition, results of operations and prospects.

Risks Related to Regulatory Approval and Other Legal Compliance Matters

The regulatory approval process of the FDA is lengthy, time-consuming and inherently unpredictable, and if we are ultimately unable to obtain regulatory approval for our product candidates, our business will be substantially harmed.

The time required to obtain approval by the FDA is unpredictable but typically takes many years following the commencement of clinical trials and depends upon numerous factors, including the substantial discretion of the regulatory authorities. In addition, approval policies, regulations or the type and amount of clinical data necessary to gain approval may change during the course of a product candidate's clinical development and may vary among jurisdictions. We have not obtained regulatory approval for any product candidate and it is possible that none of our existing product candidates, or any product candidates we may seek to develop in the future, will ever obtain regulatory approval.

Our product candidates could 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 product candidate is safe, pure and potent or effective for its proposed indication;
- 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;
- data collected from clinical trials of our product candidates may not be sufficient to support the submission of a BLA to the FDA or other submission or to obtain regulatory approval in the United States;
- the FDA may find deficiencies with or fail to approve the manufacturing processes or facilities of third-party manufacturers with which we 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.

This lengthy approval process as well as the unpredictability of future clinical trial results may result in our failing to obtain regulatory approval to market any of our product candidates, which would significantly harm our business, results of operations and prospects. The FDA has substantial discretion in the approval process, and determining when or whether regulatory approval will be obtained for any of our product candidates. Even if we believe the data collected from clinical trials of our product candidates are promising, such data may not be sufficient to support approval by the FDA.

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, 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.

Even if we complete the necessary preclinical studies and clinical trials, the marketing approval process is expensive, time-consuming and uncertain and may prevent us or any future collaborators from obtaining approvals for the commercialization of some or all of our product candidates. As a result, we cannot predict when or if, and in which territories, we, or any future collaborators, will obtain marketing approval to commercialize a product candidate.

The research, testing, manufacturing, labeling, approval, selling, marketing, promotion and distribution of drug products are subject to extensive regulation by the FDA, EMA and other regulatory authorities, and regulations may differ from country to country. We, and any future collaborators, are not permitted to market our product candidates in the United States or in other countries until we, or they, receive approval of a BLA from the FDA, approval of a marketing authorization application, or MAA, from the EMA, or marketing approval from other applicable regulatory authorities. Our product candidates are in various stages of development and are subject to the risks of failure inherent in drug development. We have not submitted an application for or received marketing approval for any of our product candidates in the United States, Europe or in any other jurisdiction. We have not yet been successful at conducting and managing the clinical trials necessary to obtain marketing approvals, including FDA approval of a BLA and EMA approval of an MAA.

The process of obtaining marketing approvals, both in the United States and abroad, is lengthy, expensive and uncertain. It may take many years, 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.

In addition, changes in marketing approval policies during the development period, changes in or the enactment or promulgation of additional statutes, regulations or guidance or changes in regulatory review for each submitted product application, may cause delays in the approval or rejection of an application. Regulatory authorities have 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. In addition, varying interpretations of the data obtained from preclinical studies and clinical trials could delay, limit or prevent marketing approval of a product candidate. Any marketing approval we, or any future collaborators, ultimately obtain may be limited or subject to restrictions or post-approval commitments that render the approved product not commercially viable.

Any delay in obtaining or failure to obtain required approvals could materially adversely affect our ability or that of any future collaborators to generate revenue from the particular product candidate, which likely would result in significant harm to our financial position and adversely impact our stock price.

Failure to obtain marketing approval in foreign jurisdictions would prevent our product candidates from being marketed abroad and may limit our ability to generate revenue from product sales.

In order to market and sell our products in the European Union and many other jurisdictions, we, and any future collaborators, must obtain separate marketing approvals and comply with numerous and varying regulatory requirements. The approval procedure varies among countries and can involve additional testing. The time required to obtain approval may differ substantially from that required to obtain FDA approval. The marketing approval process outside the United States generally includes all of the risks associated with obtaining FDA approval. We, and any future collaborators, may not obtain approvals from regulatory authorities outside the United States on a timely basis, if at all. Approval by the FDA does not ensure approval by regulatory authorities in other countries or jurisdictions, and approval by one regulatory authority outside the United States does not ensure approval by regulatory authorities in other countries or jurisdictions or by the FDA.

In many countries outside the United States, a product candidate must also be approved for reimbursement before it can be sold in that country. In some cases, the price that we intend to charge for our products, if approved, is also subject to approval. Obtaining non-U.S. regulatory approvals and compliance with non-U.S. regulatory requirements could result in significant delays, difficulties and costs for us and any future collaborators and could delay or prevent the introduction of our product candidates in certain countries. In addition, if we or any future collaborators fail to obtain the non-U.S. approvals required to market our product candidates outside the United States or if we or any future collaborators fail to comply with applicable non-U.S. regulatory requirements, our target market will be reduced and our ability to realize the full market potential of our product candidates will be harmed and our business, financial condition, results of operations and prospects may be adversely affected.

We, or any future collaborators, may not be able to obtain and maintain orphan drug exclusivity for our product candidates in the United States and Europe.

Regulatory authorities in some jurisdictions, including the United States and Europe, may designate drugs and biologics for relatively small patient populations as orphan drugs. Under the Orphan Drug Act, the FDA may designate a product as an orphan drug if it is a drug or biologic intended to treat a rare disease or condition, which is generally defined as a patient population of fewer than 200,000 individuals annually in the United States. In November 2015, the FDA granted orphan drug designation to MRT5005 for the treatment of CF, and in March 2018, the FDA granted orphan drug designation to MRT5201 for the treatment of OTC deficiency. We may seek orphan drug designations for MRT5005 and MRT5201 for other indications or for other of our product candidates. There can be no assurances that we will be able to obtain such designations.

Even if we, or any future collaborators, obtain orphan drug designation for a product candidate as we have obtained for MRT5005 for the treatment of CF and for MRT5201 for the treatment of OTC deficiency, we, or they, may not be able to obtain or maintain orphan drug exclusivity for that product candidate. Generally, if a product with an orphan drug designation subsequently receives the first marketing approval for the indication for which it has such designation, the product is entitled to a period of marketing exclusivity, which precludes the EMA or the FDA from approving another marketing application for the same product for that time period. The applicable period is seven years in the United States and ten years in Europe. The European exclusivity period can be reduced to six years if a product no longer meets the criteria for orphan drug designation or if the product is sufficiently profitable so that market exclusivity is no longer justified. Orphan drug exclusivity may be lost if the FDA or EMA determines that the request for designation was materially defective or if the manufacturer is unable to assure sufficient quantity of the product to meet the needs of patients with the rare disease or condition. Moreover, even after an orphan drug is approved, the FDA can subsequently approve a different product for the same condition if the FDA concludes that the later product is clinically superior in that it is shown to be safer, more effective or makes a major contribution to patient care.

On August 3, 2017, Congress passed the FDA Reauthorization Act of 2017, or FDARA. FDARA, among other things, codified the FDA's pre-existing regulatory interpretation, to require that a drug sponsor demonstrate the clinical superiority of an orphan drug that is otherwise the same as a previously approved drug for the same rare disease in order to receive orphan drug exclusivity. The new legislation reverses prior precedent holding that the Orphan Drug Act unambiguously requires that the FDA recognize the orphan exclusivity period regardless of a showing of clinical superiority. The FDA may further reevaluate the Orphan Drug Act and its regulations and policies. We do not know if, when, or how the FDA may change the orphan drug regulations and policies in the future, and it is uncertain how any changes might affect our business. Depending on what changes the FDA may make to its orphan drug regulations and policies, our business could be adversely impacted.

We may seek fast track designation by the FDA for one or more of our product candidates, but we might not receive such designation, and even if we do, such designation may not actually lead to a faster development or regulatory review or approval process.

If a product is intended for the treatment of a serious or life-threatening condition and the product demonstrates the potential to address unmet needs for this condition, the treatment sponsor may apply for FDA fast track designation. If we seek fast track

designation for a product candidate, we may not receive it from the FDA. However, even if we receive fast track designation, fast track designation does not ensure that we will receive marketing approval or that approval will be granted within any particular timeframe. We may not experience a faster development, regulatory review or approval process with fast track designation compared to conventional FDA procedures. Additionally, the FDA may withdraw fast track designation if it believes that the designation is no longer supported by data from our clinical development program. Fast track designation alone does not guarantee qualification for the FDA's priority review procedures.

A breakthrough therapy designation by the FDA for a product candidate may not lead to a faster development or regulatory review or approval process, and it would not increase the likelihood that the product candidate will receive marketing approval.

We may seek a breakthrough therapy designation for one or more product candidates. A breakthrough therapy is defined as a product candidate that is intended, alone or in combination with one or more other drugs, to treat a serious or life-threatening disease or condition, and preliminary clinical evidence indicates that the product candidate may demonstrate substantial improvement over existing therapies on one or more clinically significant endpoints, such as substantial treatment effects observed early in clinical development. For product candidates that have been designated as breakthrough therapies, interaction and communication between the FDA and the sponsor of the trial can help to identify the most efficient path for clinical development while minimizing the number of patients placed in ineffective control regimens. Product candidates designated as breakthrough therapies by the FDA are also eligible for priority review if supported by clinical data at the time of the submission of the BLA.

Designation as a breakthrough therapy is within the discretion of the FDA. Accordingly, even if we believe that one of our product candidates meets the criteria for designation as a breakthrough therapy, the FDA may disagree and instead determine not to make such designation. In any event, the receipt of a breakthrough therapy designation for a product candidate may not result in a faster development process, review or approval compared to product candidates considered for approval under conventional FDA procedures and it would not assure ultimate approval by the FDA. In addition, even if one or more of our product candidates qualify as breakthrough therapies, the FDA may later decide that the product candidate no longer meets the conditions for qualification or it may decide that the time period for FDA review or approval will not be shortened.

Even if we, or any future collaborators, obtain marketing approvals for our product candidates, the terms of approvals and ongoing regulation of our products may limit how we, or they, manufacture and market our products, which could materially impair our ability to generate revenue.

Once marketing approval has been granted, an approved product and its manufacturer and marketer are subject to ongoing review and extensive regulation. We, and any future collaborators, must therefore comply with requirements concerning advertising and promotion for any of our product candidates for which we or they obtain marketing approval. Promotional communications with respect to prescription drugs are subject to a variety of legal and regulatory restrictions and must be consistent with the information in the product's approved labeling. Thus, we, and any future collaborators, will not be able to promote any products we develop for indications or uses for which they are not approved.

In addition, manufacturers of approved products and those manufacturers' facilities are required to comply with extensive FDA requirements, including ensuring that quality control and manufacturing procedures conform to cGMPs, which include requirements relating to quality control and quality assurance as well as the corresponding maintenance of records and documentation and reporting requirements. We, our third-party manufacturers, any future collaborators and their third-party manufacturers could be subject to periodic unannounced inspections by the FDA to monitor and ensure compliance with cGMPs.

Accordingly, assuming we, or any future collaborators, receive marketing approval for one or more of our product candidates, we, and any future collaborators, and our respective third-party manufacturers will continue to expend time, money and effort in all areas of regulatory compliance, including manufacturing, production, product surveillance and quality control.

If we, and any future collaborators, are not able to comply with post-approval regulatory requirements, we, and any future collaborators, could have the marketing approvals for our products withdrawn by regulatory authorities and our, or any future collaborators', ability to market any future products could be limited, which could adversely affect our ability to achieve or sustain profitability. Further, the cost of compliance with post-approval regulations may have a negative effect on our operating results and financial condition.

Any of our product candidates for which we, or any future collaborators, obtain marketing approval in the future could be subject to post-marketing restrictions or withdrawal from the market and we, or any future collaborators, may be subject to substantial penalties if we, or they, fail to comply with regulatory requirements or if we, or they, experience unanticipated problems with our products following approval.

Any of our product candidates for which we, or any future collaborators, obtain marketing approval in the future, as well as the manufacturing processes, post-approval studies and measures, labeling, advertising and promotional activities for such product, among other things, will be subject to continual requirements of and review by the FDA, EMA and other regulatory authorities. These requirements include submissions of safety and other post-marketing information and reports, registration and listing requirements, requirements relating to manufacturing, quality control, quality assurance and corresponding maintenance of records and documents, requirements regarding the distribution of samples to physicians and recordkeeping. Even if marketing approval of a product candidate is granted, the approval may be subject to limitations on the indicated uses for which the product may be marketed or to the conditions of approval, including the requirement to implement a REMS.

The FDA may also impose requirements for costly post-marketing studies or clinical trials and surveillance to monitor the safety or efficacy of a product. The FDA and other agencies, including the Department of Justice, closely regulate and monitor the post-approval marketing and promotion of products to ensure that they are manufactured, marketed and distributed only for the approved indications and in accordance with the provisions of the approved labeling. The FDA imposes stringent restrictions on manufacturers' communications regarding off-label use and if we, or any future collaborators, do not market any of our product candidates for which we, or they, receive marketing approval for only their approved indications, we, or they, may be subject to warnings or enforcement action for off-label marketing. Violation of the Federal Food, Drug, and Cosmetic Act and other statutes, including the False Claims Act, relating to the promotion and advertising of prescription drugs may lead to investigations or allegations of violations of federal and state health care fraud and abuse laws and state consumer protection laws.

In addition, later discovery of previously unknown side effects or other problems with our products or their manufacturers or manufacturing processes, or failure to comply with regulatory requirements, may yield various results, including:

- restrictions on such products, manufacturers or manufacturing processes;
- restrictions on the labeling or marketing of a product;
- restrictions on product distribution or use;
- requirements to conduct post-marketing studies or clinical trials;
- warning letters or untitled letters;
- withdrawal of the products from the market;
- refusal to approve pending applications or supplements to approved applications that we submit;
- recall of products;
- restrictions on coverage by third-party payors;
- fines, restitution or disgorgement of profits or revenue;
- suspension or withdrawal of marketing approvals, including license revocation;
- refusal to permit the import or export of products;
- product seizure; and
- injunctions or the imposition of civil or criminal penalties.

Our relationships with health care providers, physicians and third-party payors will be subject to applicable anti-kickback, fraud and abuse and other health care laws and regulations, which could expose us to civil, criminal and administrative sanctions, contractual damages, reputational harm and diminished future profits and earnings.

Health care providers, physicians and third-party payors will play a primary role in the recommendation and prescription of any drugs for which we obtain marketing approval. Our future arrangements with third-party payors, health care providers and physicians may expose us to broadly applicable fraud and abuse and other health care 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. These include the following:

- *Anti-Kickback Statute*—the federal Anti-Kickback Statute prohibits, among other things, persons from knowingly and willfully soliciting, offering, receiving or providing any remuneration, directly or indirectly, in cash or in kind, to induce or

reward, or in return for, either the referral of an individual for, or the purchase, order or recommendation or arranging of, any good, facility, item or service, for which payment may be made, in whole or in part, by a federal health care program, such as Medicare and Medicaid;

- *False Claims Act*—the federal civil and criminal false claims laws impose criminal and civil penalties, including, in some cases, through civil whistleblower or qui tam actions, against individuals or entities for, among other things, knowingly presenting, or causing to be presented, false or fraudulent claims for payment by a federal health care program or knowingly making a false statement or record material to payment of a false claim or knowingly avoiding, decreasing or concealing an obligation to pay money to the federal government, with potential liability including mandatory treble damages and significant per-claim penalties;
- *HIPAA*—the federal Health Insurance Portability and Accountability Act of 1996, or HIPAA, which created additional federal criminal statutes that prohibit, among other things, executing a scheme to defraud any health care benefit program or making false statements relating to health care matters, and apply regardless of the payor (e.g., public or private);
- *HIPAA and HITECH*—HIPAA, as amended by the Health Information Technology for Economic and Clinical Health Act, or HITECH, and their implementing regulations, which impose obligations on HIPAA covered entities and their business associates, including mandatory contractual terms and required implementation of administrative, physical and technical safeguards to maintain the privacy and security of individually identifiable health information;
- *Transparency Requirements*—federal transparency laws, including the federal Physician Payments Sunshine Act, require applicable manufacturers of covered drugs to annually report payments and other transfers of value to physicians and teaching hospitals and ownership or investment interests held by physicians and their family members; and
- *Analogous State and Foreign Laws*—analogous state and foreign fraud and abuse laws and regulations, such as state anti-kickback and false claims laws, which may be broader than similar federal laws, can apply to claims involving health care items or services regardless of payor, and are enforced by many different federal and state agencies as well as through private actions.

Some state laws require pharmaceutical companies to comply with the pharmaceutical industry’s voluntary compliance guidelines and the relevant compliance guidance promulgated by the federal government and require drug manufacturers to report information related to payments and other transfers of value to physicians and other health care providers or marketing expenditures. State and foreign laws also govern the privacy and security of health information in some circumstances, many of which differ from each other in significant ways and often are not pre-empted by HIPAA, thus complicating compliance efforts.

Efforts to ensure that our business arrangements with third parties will comply with applicable health care laws and regulations will involve substantial costs. 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 health care 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/or administrative penalties, damages, fines, individual imprisonment, disgorgement, exclusion of drugs from government funded health care programs, such as Medicare and Medicaid, contractual damages, reputational harm, administrative burdens, diminished profits and future earnings, additional reporting obligations and oversight if we become subject to a corporate integrity agreement or similar agreement to resolve allegations of non-compliance with these laws and the curtailment or restructuring of our operations. If any of the physicians or other health care 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 health care programs.

The provision of benefits or advantages to physicians to induce or encourage the prescription, recommendation, endorsement, purchase, supply, order or use of medicinal products is also prohibited in the European Union. The provision of benefits or advantages to physicians is governed by the national anti-bribery laws of European Union Member States, such as the U.K. Bribery Act 2010, or the Bribery Act. Infringement of these laws could result in substantial fines and imprisonment.

Payments made to physicians in certain European Union Member States must be publicly disclosed. Moreover, agreements with physicians often must be the subject of prior notification and approval by the physician’s employer, his or her competent professional organization and/or the regulatory authorities of the individual European Union Member States. These requirements are provided in the national laws, industry codes or professional codes of conduct, applicable in the European Union Member States. Failure to comply with these requirements could result in reputational risk, public reprimands, administrative penalties, fines or imprisonment.

The collection, use, disclosure, transfer, or other processing of personal data regarding individuals in the EU, including personal health data, is subject to the EU General Data Protection Regulation, or GDPR, which became effective on May 25, 2018. The GDPR is wide-ranging in scope and imposes numerous requirements on companies that process personal data, including requirements relating to processing health and other sensitive data, obtaining consent of the individuals to whom the personal data relates, providing

information to individuals regarding data processing activities, implementing safeguards to protect the security and confidentiality of personal data, providing notification of data breaches, and taking certain measures when engaging third-party processors. The GDPR also imposes strict rules on the transfer of personal data to countries outside the EU, including the United States, and permits data protection authorities to impose large penalties for violations of the GDPR, including potential fines of up to €20 million or 4% of annual global revenues, whichever is greater. The GDPR also confers a private right of action on data subjects and consumer associations to lodge complaints with supervisory authorities, seek judicial remedies, and obtain compensation for damages resulting from violations of the GDPR. 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 European activities.

Current and future legislation may increase the difficulty and cost for us and any future collaborators to obtain marketing approval of and commercialize our product candidates and affect the prices we, or they, may obtain.

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

In March 2010, President Obama signed into law the ACA. Among the provisions of the ACA of importance to our business, including, without limitation, our ability to commercialize and the prices we may obtain for any of our product candidates, are the following:

- an annual, non-deductible fee on any entity that manufactures or imports specified branded prescription drugs and biologic products;
- an increase in the statutory minimum rebates a manufacturer must pay under the Medicaid Drug Rebate Program;
- expansion of federal health care 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% point-of-sale discounts off negotiated prices;
- extension of manufacturers' Medicaid rebate liability;
- expansion of eligibility criteria for Medicaid programs;
- 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 drug samples that manufacturers and distributors provide to physicians; and
- a new Patient-Centered Outcomes Research Institute to oversee, identify priorities in, and conduct comparative clinical effectiveness research, along with funding for such research.

In addition, other legislative changes have been proposed and adopted since the ACA was enacted. These changes include the Budget Control Act of 2011, which, among other things, led to aggregate reductions to Medicare payments to providers of 2% per fiscal year starting in 2013 and that, due to subsequent legislative amendments to the statute, will stay in effect through 2025 unless additional congressional action is taken, and the American Taxpayer Relief Act of 2012, which, among other things, reduced Medicare payments to several types of providers and increased the statute of limitations period for the government to recover overpayments to providers from three to five years. These laws and any new health care reform measures may result in additional reductions in Medicare and other health care 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. Further, there have been several recent U.S. congressional inquiries and proposed state and federal legislation designed to, among other things, bring more transparency to drug pricing, review the relationship between pricing and manufacturer patient programs, reduce the costs of drugs under Medicare and reform government program reimbursement methodologies for drug products.

We expect that these health care reforms, as well as other health care reform measures that may be adopted in the future, may result in additional reductions in Medicare, Medicaid and other health care funding, more rigorous coverage criteria, new payment methodologies and additional downward pressure on the price that we receive for any approved product and/or the level of reimbursement physicians receive for administering any approved product we might bring to market. Reductions in reimbursement

levels may negatively impact the prices we receive or the frequency with which our products are prescribed or administered. Any reduction in reimbursement from Medicare, Medicaid or other government programs may result in a similar reduction in payments from private payors.

Since enactment of the ACA, there have been numerous legal challenges and congressional actions to repeal and replace provisions of the law. In May 2017, the U.S. House of Representatives passed legislation known as the American Health Care Act of 2017. Thereafter, the Senate Republicans introduced and then updated a bill to replace the ACA known as the Better Care Reconciliation Act of 2017. The Senate Republicans also introduced legislation to repeal the ACA without companion legislation to replace it, and a “skinny” version of the Better Care Reconciliation Act of 2017. In addition, the Senate considered proposed health care reform legislation known as the Graham-Cassidy bill. None of these measures was passed by the U.S. Senate.

The Trump Administration has also taken executive actions to undermine or delay implementation of the ACA. In January 2017, President Trump signed an Executive Order directing federal agencies with authorities and responsibilities under the ACA to waive, defer, grant exemptions from, or delay the implementation of any provision of the ACA that would impose a fiscal or regulatory burden on states, individuals, health care providers, health insurers, or manufacturers of pharmaceuticals or medical devices. In October 2017, the President signed a second Executive Order allowing for the use of association health plans and short-term health insurance, which may provide fewer health benefits than the plans sold through the ACA exchanges. At the same time, the Administration announced that it will discontinue the payment of cost-sharing reduction, or CSR, payments to insurance companies until Congress approves the appropriation of funds for such CSR payments. The loss of the CSR payments is expected to increase premiums on certain policies issued by qualified health plans under the ACA.

A bipartisan bill to appropriate funds for CSR payments was introduced in the Senate, but the future of that bill is uncertain. Further, each chamber of Congress has put forth multiple bills designed to repeal or repeal and replace portions of the ACA. Although none of these measures has been enacted by Congress to date, Congress may consider other legislation to repeal and replace elements of the ACA. Congress will likely consider other legislation to replace elements of the ACA, during the next congressional session. We will continue to evaluate the effect that the ACA and its possible repeal and replacement could have on our business.

The costs of prescription pharmaceuticals in the United States have also been the subject of considerable discussion in the United States, and members of Congress and the Administration have stated that they will address such costs through new legislative and administrative measures. The pricing of prescription pharmaceuticals is also subject to governmental control outside the United States. In these countries, pricing negotiations with governmental authorities can take considerable time after the receipt of marketing approval for a product. To obtain reimbursement or pricing approval in some countries, we may be required to conduct a clinical trial that compares the cost-effectiveness of our product candidates to other available therapies. If reimbursement of our products is unavailable or limited in scope or amount, or if pricing is set at unsatisfactory levels, our ability to generate revenue and become profitable could be impaired.

Finally, legislative and regulatory proposals have also been made to expand post-approval requirements and restrict sales and promotional activities for pharmaceutical products. We cannot be sure whether additional legislative changes will be enacted, or whether the FDA regulations, guidance or interpretations will be changed, or what the impact of such changes on the marketing approvals of our product candidates, if any, may be. In addition, increased scrutiny by the U.S. Congress of the FDA’s approval process may significantly delay or prevent marketing approval, as well as subject us and any future collaborators to more stringent product labeling and post-marketing testing and other requirements.

Governments outside of the United States tend to impose strict price controls, which may adversely affect our revenues from the sales of drugs, if any.

In some countries, particularly the countries of the European Union, the pricing of prescription pharmaceuticals is subject to governmental control. In these countries, pricing negotiations with governmental authorities can take considerable time after the receipt of marketing approval for a drug. To obtain reimbursement or pricing approval in some countries, we, or our future collaborators, may be required to conduct a clinical trial that compares the cost-effectiveness of our drug to other available therapies. If reimbursement of our drugs is unavailable or limited in scope or amount, or if pricing is set at unsatisfactory levels, our business could be materially harmed.

We are subject to anti-corruption laws, as well as export control laws, customs laws, sanctions laws and other laws governing our operations. If we fail to comply with these laws, we could be subject to civil or criminal penalties, other remedial measures and legal expenses, which could adversely affect our business, results of operations and financial condition.

Our operations are subject to anti-corruption laws, including the FCPA, the Bribery Act, and other anti-corruption laws that apply in countries where we do business and may do business in the future. The FCPA, the Bribery Act, and these other laws generally prohibit us, our officers and our employees and intermediaries from bribing, being bribed or making other prohibited payments to

government officials or other persons to obtain or retain business or gain some other business advantage. We may in the future operate in jurisdictions that pose a high risk of potential FCPA or Bribery Act violations, and we may participate in collaborations and relationships with third parties whose actions could potentially subject us to liability under the FCPA, the Bribery Act, or local anti-corruption laws. In addition, we cannot predict the nature, scope or effect of future regulatory requirements to which our international operations might be subject or the manner in which existing laws might be administered or interpreted.

We are also subject to other laws and regulations governing our international operations, including regulations administered by the governments of the United States, United Kingdom, and authorities in the European Union, including applicable export control regulations, economic sanctions on countries and persons, customs requirements and currency exchange regulations, which we collectively refer to as Trade Control Laws.

There is no assurance that we will be completely effective in ensuring our compliance with all applicable anti-corruption laws, including the FCPA, the Bribery Act, or other legal requirements, including Trade Control Laws. If we are not in compliance with the FCPA, the Bribery Act, and other anti-corruption laws or Trade Control Laws, we may be subject to criminal and civil penalties, disgorgement and other sanctions and remedial measures, and legal expenses, which could have an adverse impact on our business, financial condition, results of operations and liquidity. The Securities and Exchange Commission, or SEC, also may suspend or bar issuers from trading securities on U.S. exchanges for violations of the FCPA's accounting provisions. Likewise, any investigation of any potential violations of the FCPA, the Bribery Act, other anti-corruption laws or Trade Control Laws by U.S., U.K. or other authorities could also have an adverse impact on our reputation, our business, results of operations and financial condition.

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 significantly harm 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. From time to time and in the future, our operations may involve the use of hazardous and flammable materials, including chemicals and biological materials, and may also produce hazardous waste products. Although we contract with third parties for the disposal of these materials and waste products, we cannot completely eliminate the risk of contamination or injury resulting from these materials. In the event of contamination or injury resulting from the use or disposal of our hazardous materials, we could be held liable for any resulting damages, and any liability could exceed our resources. We also could incur significant costs associated with civil or criminal fines and penalties for failure to comply with such laws and regulations.

We maintain workers' compensation insurance to cover costs and expenses we may incur due to injuries to our employees resulting from the use of hazardous materials, but this insurance may not provide adequate coverage against potential liabilities. We do not maintain insurance for environmental liability or toxic tort claims that may be asserted against us. In addition, we may incur substantial costs in order to comply with current or future environmental, health and safety laws and regulations. Current or future environmental laws and regulations may impair our research, development or production efforts, which could adversely affect our business, financial condition, results of operations or prospects. In addition, failure to comply with these laws and regulations may result in substantial fines, penalties or other sanctions.

Risks Related to Ownership of Our Common Stock

Our executive officers, directors and principal stockholders maintain the ability to control all matters submitted to stockholders for approval.

We believe our executive officers, directors and stockholders which own more than 5% of our outstanding common stock, in the aggregate, beneficially own more than a majority of our capital stock. One of our directors is affiliated with a stockholder who beneficially owns more than 5% of our outstanding common stock. If these stockholders were to act together, they would be able to control all matters submitted to our stockholders for approval, as well as our management and business affairs. For example, these persons, if they act together, would control the election of directors and approval of any merger, consolidation or sale of all or substantially all of our assets. This concentration of voting power could delay or prevent an acquisition of our company on terms that other stockholders may desire or result in management of our company that other stockholders disagree with.

A significant portion of our total outstanding shares are restricted from immediate resale but may be sold into the market in the near future, which could cause the market price of our common stock to drop significantly, even if our business is performing well.

Sales of a substantial number of shares of our common stock in the public market could occur at any time, subject to certain restrictions described below. 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. As of October 31, 2018, we had 45,142,090 shares of our common stock outstanding. Of these shares, 35,427,667 shares are currently restricted as a result of securities laws or lock-up agreements but will be

able to be sold after the expiration of the lock-up period. This lock-up period, which was in effect for 180 days after the date of the prospectus for our initial public offering, ends on December 24, 2018.

Moreover, beginning 180 days after the completion of our initial public offering, holders of an aggregate of approximately 32,597,434 shares of our common stock will have rights, subject to certain 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. In July 2018, we registered all shares of common stock that we may issue under our equity compensation plans. These shares can be freely sold in the public market upon issuance, subject to volume limitations applicable to affiliates and the lock-up agreements entered into in connection with our initial public offering.

If securities analysts do not publish research or reports about our business or if they publish negative evaluations of our stock, the price of our stock could decline.

The trading market for our common stock will rely, in part, on the research and reports that industry or financial analysts publish about us or our business. There can be no assurance that existing analysts will continue to cover us or that new analysts will begin to cover us. There is also no assurance that any covering analyst will provide favorable coverage. A lack of research coverage or adverse coverage may negatively impact the market price of our common stock. In addition, if one or more of the analysts covering our business downgrade their evaluations of our stock, the price of our stock could decline. If one or more of these analysts cease to cover our stock, we could lose visibility in the market for our stock, which in turn could cause our stock price to decline.

The price of our common stock is volatile and may fluctuate substantially, which could result in substantial losses for purchasers of our common stock.

Our stock price is volatile. The stock market in general, and the market for biopharmaceutical companies in particular, has experienced extreme volatility that has often been unrelated to the operating performance of particular companies. The market price for our common stock may be influenced by many factors, including:

- results of preclinical studies and clinical trials of our product candidates or those of our competitors;
- the success of competitive products or technologies;
- commencement or termination of collaborations;
- regulatory or legal developments in the United States and other countries;
- developments or disputes concerning patent applications, issued patents or other proprietary rights;
- the recruitment or departure of key personnel;
- the level of expenses related to any of our product candidates or clinical development programs;
- the results of our efforts to discover, develop, acquire or in-license additional product candidates;
- actual or anticipated changes in estimates as to financial results, development timelines or recommendations by securities analysts;
- variations in our financial results or those of companies that are perceived to be similar to us;
- changes in the structure of health care payment systems;
- market conditions in the pharmaceutical and biotechnology sectors;
- the entry into significant acquisitions, strategic partnerships or divestitures by us or our competitors;
- significant sales of our common stock, including sales by our directors, executive officers or 5% stockholders;
- general economic, industry and market conditions; and
- the other factors described in this “Risk Factors” section.

If any of the foregoing matters were to occur, or if our operating results fall below the expectations of investors or securities analysts, the price of our common stock could decline substantially. In the past, following periods of volatility in the market price of a company’s securities, securities class-action litigation often has been instituted against that company. Such litigation, if instituted against us, could cause us to incur substantial costs to defend such claims and divert management’s attention and resources, which could seriously harm our business, financial condition, results of operations and prospects.

An active trading market for our common stock may not be sustained.

Our shares of common stock began trading on the Nasdaq Global Select Market on June 28, 2018. Given the limited trading history of our common stock, there is a risk that an active trading market for our shares will not be sustained, which could put downward pressure on the market price for our common stock and thereby affect the ability of our stockholders to sell their shares. An inactive trading market may also impair our ability to raise capital to continue to fund operations by selling shares and may impair our ability to acquire other companies or technologies by using our shares as consideration.

We are an “emerging growth company,” and the reduced disclosure requirements applicable to emerging growth companies may make our common stock less attractive to investors.

We are an “emerging growth company,” or EGC, as defined in the Jumpstart Our Business Startups Act of 2012, or the JOBS Act. We will remain an EGC until the earlier of: (i) the last day of the fiscal year in which we have total annual gross revenue of \$1.07 billion or more; (ii) the last day of the fiscal year following the fifth anniversary of the date of our initial public offering; (iii) the date on which we have issued more than \$1 billion in nonconvertible debt during the previous three years; or (iv) the date on which we are deemed to be a large accelerated filer under the rules of the SEC, which means the last day of the first year in which the market value of our common stock that is held by non-affiliates exceeds \$700 million as of June 30. For so long as we remain an EGC, we are permitted and intend to rely on exemptions from certain disclosure requirements that are applicable to other public companies that are not EGCs. These exemptions include:

- not being required to comply with the auditor attestation requirements in the assessment of our internal control over financial reporting;
- reduced disclosure obligations regarding executive compensation;
- exemptions from the requirements of holding a nonbinding advisory vote on executive compensation and stockholder approval of any golden parachute payments not previously approved; and
- an exemption from compliance with the requirement of the Public Company Accounting Oversight Board regarding the communication of critical audit matters in the auditor’s report on the financial statements.

Investors may find our common stock less attractive as a result of our reliance on these exemptions. If some investors find our common stock less attractive as a result, there may be a less active trading market for our common stock and our stock price may be more volatile.

In addition, the JOBS Act provides that an EGC may take advantage of an extended transition period for complying with new or revised accounting standards. This allows an EGC to delay the adoption of certain accounting standards until those standards would otherwise apply to private companies. We have irrevocably elected not to avail ourselves of this exemption from new or revised accounting standards and, therefore, we will be subject to the same new or revised accounting standards as other public companies that are not EGCs.

We will incur increased costs as a result of operating as a public company, and our management will be required to devote substantial time to new compliance initiatives and requirements.

As a public company, and particularly after we are no longer an EGC, we will incur significant legal, accounting and other expenses that we did not incur as a private company. In addition, the Sarbanes-Oxley Act of 2002, or the Sarbanes-Oxley Act, and rules subsequently implemented by the SEC and the Nasdaq Stock Market have imposed various requirements on public companies, including establishment and maintenance of effective disclosure and financial controls and corporate governance practices. Our management and other personnel will need to devote a substantial amount of time to these compliance initiatives. Moreover, these rules and regulations will increase our legal and financial compliance costs and will make some activities more time-consuming and costly. For example, we expect that these rules and regulations may make it more difficult and more expensive for us to obtain director and officer liability insurance, which could make it more difficult for us to attract and retain qualified members of our board of directors.

If we fail to maintain an effective system of internal control over financial reporting, we may not be able to accurately report our financial results or prevent fraud. As a result, stockholders could lose confidence in our financial and other public reporting, which would harm our business and the trading price of our common stock.

Effective internal control over financial reporting is necessary for us to provide reliable financial reports and, together with adequate disclosure controls and procedures, is designed to prevent fraud. Any failure to implement required new or improved controls, or difficulties encountered in their implementation, could cause us to fail to meet our reporting obligations. In addition, any testing by us, as and when required, conducted in connection with Section 404 of the Sarbanes-Oxley Act, or Section 404, or any subsequent testing by our independent registered public accounting firm, as and when required, may reveal deficiencies in our internal

control over financial reporting that are deemed to be significant deficiencies or material weaknesses or that may require prospective or retroactive changes to our financial statements or identify other areas for further attention or improvement. Inferior internal controls could also cause investors to lose confidence in our reported financial information, which could have a negative effect on the trading price of our common stock.

Pursuant to Section 404, we are required to furnish a report by our management on our internal control over financial reporting, including an attestation report on internal control over financial reporting issued by our independent registered public accounting firm. However, while we remain an EGC, we will not be required to include an attestation report on internal control over financial reporting issued by our independent registered public accounting firm. To achieve compliance with Section 404 within the prescribed period, we will be engaged in a process to document and evaluate our internal control over financial reporting, which is both costly and challenging. In this regard, we will need to continue to dedicate internal resources, potentially engage outside consultants and adopt a detailed work plan to assess and document the adequacy of internal control over financial reporting, continue steps to improve control processes as appropriate, validate through testing that controls are functioning as documented and implement a continuous reporting and improvement process for internal control over financial reporting. Despite our efforts, there is a risk that neither we nor our independent registered public accounting firm will be able to conclude within the prescribed timeframe that our internal control over financial reporting is effective as required by Section 404. This could result in an adverse reaction in the financial markets due to a loss of confidence in the reliability of our financial statements.

We have identified a material weakness in our internal control over financial reporting. If we are unable to remediate this material weakness, or if we identify additional material weaknesses in the future or otherwise fail to maintain an effective system of internal controls, we may not be able to accurately or timely report our financial condition or results of operations, which may adversely affect our business and stock price.

We have identified a material weakness in our internal control over financial reporting. A material weakness is a deficiency, or a combination of deficiencies, in internal control over financial reporting, such that there is a reasonable possibility that a material misstatement of our annual or interim financial statements will not be prevented or detected on a timely basis.

In preparation of our financial statements to meet the requirements of our initial public offering, we determined that a material weakness in our internal control over financial reporting existed during fiscal 2016 and remained unremediated as of December 31, 2017. The material weakness we identified is that we did not design and maintain effective controls and procedures over our accounting for and reporting of the income tax impacts of business combinations. This control deficiency could result in a misstatement of our accounts or disclosures that would result in a material misstatement of our annual or interim condensed consolidated financial statements that would not be prevented or detected, and accordingly, we determined that the control deficiency constitutes a material weakness. The material weakness also resulted in revisions to our previously issued 2016 annual consolidated financial statements, which we concluded were not material to those financial statements, and adjustments to our interim condensed consolidated financial statements for the nine months ended September 30, 2017 before their issuance. Specifically, the material weakness resulted in errors in our accounting for and reporting of income taxes and goodwill in the purchase accounting for a business combination and in subsequent reporting periods.

We are in the process of implementing a remediation plan designed to improve our internal control over financial reporting and remediate the control deficiency that led to this material weakness.

We cannot assure you that the measures we have taken to date, and actions we may take in the future, will be sufficient to remediate the control deficiencies that led to our material weakness in our internal control over financial reporting or that they will prevent or avoid potential future material weaknesses. In addition, neither our management nor an independent registered public accounting firm has performed an evaluation of our internal control over financial reporting in accordance with the provisions of the Sarbanes-Oxley Act because no such evaluation has been required. Had we or our independent registered public accounting firm performed an evaluation of our internal control over financial reporting in accordance with the provisions of the Sarbanes-Oxley Act, additional material weaknesses may have been identified. If we are unable to successfully remediate our existing or any future material weaknesses in our internal control over financial reporting, or identify any additional material weaknesses in the future, or otherwise fail to maintain an effective system of internal controls, the accuracy and timing of our financial reporting may be adversely affected, we may be unable to maintain compliance with securities law requirements regarding timely filing of periodic reports in addition to applicable stock exchange listing requirements, investors may lose confidence in our financial reporting, and our share price may decline as a result.

Provisions in our certificate of incorporation and bylaws and under Delaware law could make an acquisition of us, which may be beneficial to our stockholders, more difficult and may prevent attempts by our stockholders to replace or remove our current management.

Provisions in our certificate of incorporation and our bylaws may discourage, delay or prevent a merger, acquisition or other change in control of us that stockholders may consider favorable, including transactions in which you might otherwise receive a premium for your shares. These provisions also could limit the price that investors might be willing to pay in the future for shares of our common stock, thereby depressing the market price of our common stock. In addition, because our board of directors is responsible for appointing the members of our management team, these provisions may frustrate or prevent any attempts by our

stockholders to replace or remove our current management by making it more difficult for stockholders to replace members of our board of directors. Among other things, these provisions:

- establish a classified board of directors such that not all members of the board are elected at one time;
- allow the authorized number of our directors to be changed only by resolution of our board of directors;
- limit the manner in which stockholders can remove directors from the board;
- establish advance notice requirements for stockholder proposals that can be acted on at stockholder meetings and nominations to our board of directors;
- require that stockholder actions must be effected at a duly called stockholder meeting and prohibit actions by our stockholders by written consent;
- limit who may call stockholder meetings;
- authorize our board of directors to issue preferred stock without stockholder approval, which could be used to institute a stockholder rights plan, or so-called “poison pill,” that would work to dilute the stock ownership of a potential hostile acquirer, effectively preventing acquisitions that have not been approved by our board of directors; and
- require the approval of the holders of at least 75% of the votes that all our stockholders would be entitled to cast to amend or repeal certain provisions of our certificate of incorporation or bylaws.

Moreover, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporation Law, which prohibits a person who owns in excess of 15% of our outstanding voting stock from merging or combining with us for a period of three years after the date of the transaction in which the person acquired in excess of 15% of our outstanding voting stock, unless the merger or combination is approved in a prescribed manner.

Our certificate of incorporation provides that the Court of Chancery of the State of Delaware will be the exclusive forum for substantially all disputes between us and our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us or our directors, officers, employees or stockholders.

Our certificate of incorporation provides that the Court of Chancery of the State of Delaware is the exclusive forum for any derivative action or proceeding brought on our behalf, any action asserting a breach of fiduciary duty owed by our directors, officers, other employees or stockholders to the company or our stockholders, any action asserting a claim against us arising pursuant to the Delaware General Corporation Law or as to which the Delaware General Corporation Law confers jurisdiction on the Court of Chancery of the State of Delaware, or any action asserting a claim arising pursuant to our certificate of incorporation or our bylaws or governed by the internal affairs doctrine. This provision may limit a stockholder's ability to bring a claim in a judicial forum that it finds favorable for disputes with us or our directors, officers, other employees or other stockholders, which may discourage such lawsuits against us and our directors, officers, other employees or other stockholders. Alternatively, if a court were to find this provision in our certificate of incorporation to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions, which could adversely affect our business and financial condition.

Because we do not anticipate paying any cash dividends on our capital stock in the foreseeable future, capital appreciation, if any, will be your sole source of gain.

We have never declared or paid cash dividends on our capital stock. We currently intend to retain all of our future earnings, if any, to finance the growth and development of our business. As a result, capital appreciation, if any, of our common stock will be your sole source of gain for the foreseeable future, and investors seeking cash dividends should not purchase shares of our common stock.

Item 2. Unregistered Sales of Equity Securities and Use of Proceeds.

Sales of Unregistered Securities

Set forth below is information regarding shares of common stock issued, and options granted, by us during the three months ended September 30, 2018 that were not registered under the Securities Act of 1933, as amended, or the Securities Act. Included is the consideration, if any, we received for such shares and options and information relating to the section of the Securities Act, or rule of the SEC under which exemption from registration was claimed. None of the below transactions involved any underwriters, underwriting discounts or commissions, or any public offering.

On July 2, 2018, in connection with the closing of our IPO, we issued 183,619 shares of common stock to Shire in satisfaction of certain contractual obligations under an asset purchase agreement with Shire, based on the IPO price of \$13.00 per share. The shares of common stock issued to Shire were exempt from registration pursuant to Section 4(a)(2) of the Securities Act because the issuance did not involve a public offering and was not accompanied by any general advertisement or general solicitation.

Use of Proceeds from Initial Public Offering of Common Stock

On July 2, 2018, we closed our IPO of 9,350,000 shares of common stock at a public offering price of \$13.00 per share, and on July 24, 2018, we issued and sold an additional 364,371 shares of common stock at a price of \$13.00 per share pursuant to the exercise of the underwriters' over-allotment option. The aggregate gross proceeds to us from our IPO, inclusive of the over-allotment exercise, were \$126.3 million. The offer and sale of all of the shares in the offering were registered under the Securities Act pursuant to registration statement on Form S-1 (File No. 333-225368), which was declared effective by the SEC on June 27, 2018. Citigroup Global Markets Inc., Leerink Partners LLC and Evercore Group L.L.C. acted as joint book-running managers for the offering and as representatives of the underwriters. The offering commenced on June 27, 2018 and did not terminate until the sale of all of the shares offered.

Aggregate net proceeds from the offering, inclusive of the proceeds from the over-allotment exercise, were \$113.2 million, after deducting underwriting discounts and commissions of \$8.8 million and estimated offering expenses of \$4.3 million payable by us. None of the underwriting discounts and commissions or offering expenses were paid directly or indirectly to any directors or officers of ours or their associates or to persons owning 10% or more of any class of equity securities or to any affiliates of ours.

As of September 30, 2018, we have used approximately \$3.9 million of the net proceeds to fund the development of MRT5005 and MRT5201, to fund the discovery and additional preclinical research and development of additional product candidates and platform enhancement, and for working capital and other general corporate purposes. There has been no material change in our planned use of the net proceeds from the offering as described in our Prospectus.

Item 6. Exhibits.

Exhibit Number	Description
3.1	Restated Certificate of Incorporation of Translate Bio, Inc. (incorporated by reference to Exhibit 3.1 to the Registrant's Current Report on Form 8-K filed on July 2, 2018).
3.2	Amended and Restated Bylaws of Translate Bio, Inc. (incorporated by reference to Exhibit 3.2 to the Registrant's Current Report on Form 8-K filed on July 2, 2018).
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 Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.
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 Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.
32.1*	Certification of Principal Executive Officer 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 Section 906 of the Sarbanes-Oxley Act of 2002.
101.INS	XBRL Instance Document
101.SCH	XBRL Taxonomy Extension Schema Document
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document
101.LAB	XBRL Taxonomy Extension Label Linkbase Document
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document

* Filed herewith.

**Certification of Principal Executive Officer pursuant to Exchange Act Rules 13a-14(a)
and 15d-14(a), as adopted pursuant to Section 302 of Sarbanes-Oxley Act of 2002**

I, Ronald C. Renaud, Jr., certify that:

1. I have reviewed this Quarterly Report on Form 10-Q of Translate Bio, Inc.;
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(s) 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)) 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) 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
 - c) 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(s) 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.

Translate Bio, Inc.

/s/ Ronald C. Renaud, Jr.
Ronald C. Renaud, Jr.
Chief Executive Officer

Dated: November 8, 2018

**Certification of Principal Financial Officer pursuant to Exchange Act Rules 13a-14(a)
and 15d-14(a), as adopted pursuant to Section 302 of Sarbanes-Oxley Act of 2002**

I, John Schroer, certify that:

1. I have reviewed this Quarterly Report on Form 10-Q of Translate Bio, Inc.;
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(s) 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)) 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) 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
 - c) 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(s) 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.

Translate Bio, Inc.

/s/ John Schroer

John Schroer

Principal Financial Officer and Chief Financial Officer

Dated: November 8, 2018

**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 Quarterly Report on Form 10-Q of Translate Bio, Inc. (the "Company") for the quarter ended September 30, 2018 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), the undersigned, Ronald C. Renaud, Jr., Chief Executive Officer of the Company, hereby certifies, pursuant to Section 1350 of Chapter 63 of Title 18, United States Code, that to his knowledge:

- (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 results of operations of the Company.

Dated: November 8, 2018

/s/ Ronald C. Renaud, Jr.

Ronald C. Renaud, Jr.

President and Chief Executive Officer

A signed original of this written statement required by Section 906 has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.

**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 Quarterly Report on Form 10-Q of Translate Bio, Inc. (the "Company") for the quarter ended September 30, 2018 as filed with the Securities and Exchange Commission on the date hereof (the "Report"), the undersigned, John Schroer, Chief Financial Officer of the Company, hereby certifies, pursuant to Section 1350 of Chapter 63 of Title 18, United States Code, that to his knowledge:

- (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 results of operations of the Company.

Dated: November 8, 2018

/s/ John Schroer

John Schroer
Principal Financial Officer and Chief Financial Officer

A signed original of this written statement required by Section 906 has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.

